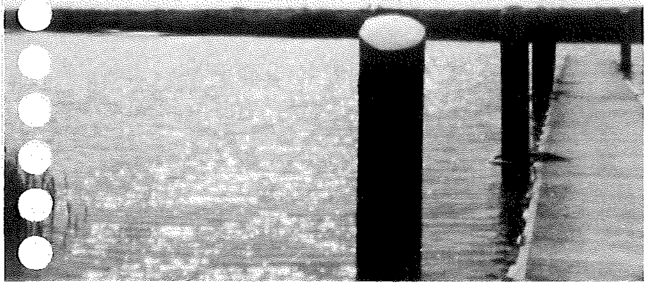

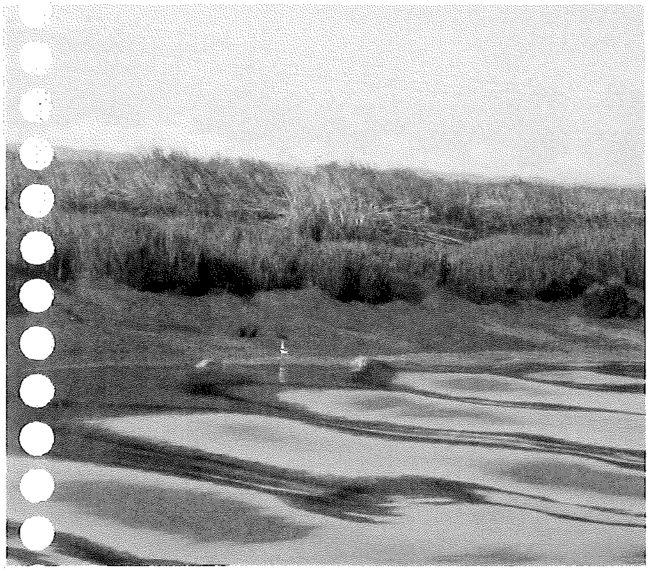

FINAL ENGINEER'S REPORT

Alviso Slough Restoration Project

October 2009

Santa Clara Valley Water District

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List of Acronyms and Abbreviations

ac	acres
BCDC	San Francisco Bay Conservation and Development Commission
CBD	community benefits district
CCC	California Coastal Conservancy
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
cfs	cubic feet per second
c.y.	cubic yard
deg. C	degrees Celsius
District	Santa Clara Valley Water District
EIR	Environmental Impact Report
LGRP	Lower Guadalupe River Flood Protection Project
mg/L	milligrams per liter
MMRP	Mitigation, Monitoring, and Reporting Program
NEPA	National Environmental Policy Act
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
PBT	Persistent Bioaccumulative Toxicants
PCB	Polychlorinated Biphenyls
ppm	parts per million
RWQCB	Regional Water Quality Control Board
SCVWD	Santa Clara Valley Water District
SBSP	South Bay Salt Pond
SBYC	South Bay Yacht Club
UPRR	Union Pacific Rail Road
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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Executive Summary

Introduction

The community of Alviso is located along the edge of South San Francisco Bay, seven miles northwest of downtown San Jose, in the natural floodplains of two major watercourses, Coyote Creek and the Guadalupe River. Alviso Slough was historically used for commerce and recreational boating; however, the reach of downstream of the Gold Street Bridge has experienced a gradual decline in channel width and increasing encroachment from vegetation over many years. These conditions have come about in the past century, primarily because of human activities, such as the manipulation of the South Bay marshlands and drainage channels for both salt-making (evaporator ponds) and agricultural purposes. Realignment of channel meanders for more efficient flow conveyance, groundwater over-pumping (resulting in subsidence of low-lying areas), and urban development have also played a role in redefining the natural course and flow conveyance of both the Guadalupe River and Alviso Slough. These anthropogenic influences, combined with natural processes attempting to achieve a level of equilibrium, have resulted in a reduced channel width and depth, precluding use of the slough for navigation and recreational access. For many years, members of the community of Alviso have requested restored access to the slough for its historic use.

The Santa Clara Valley Water District (District) Board approved a motion on January 20, 2004 directing staff to "prepare a project that includes the following: Phase 1, removal of 7 acres of vegetation and root mass to a depth of four feet on both banks of the Alviso Slough from the Gold Street Bridge to the County Marina; and then in the following year a long term project related to bringing in salt water."

Project Objectives

Project objectives aid in identifying a range of suitable and feasible project alternatives. Following the January 2004 Board directive, District staff entered into a collaborative agreement with members of the Alviso community (Alviso and Lower Guadalupe Collaborative, Appendix B) in an effort to develop a project that would meet the interests of the community. Through the collaborative effort, the following project objectives were established:

- Restore Alviso Slough's channel width and habitat to prior to 1983 conditions;
- Improve the community's ability to pursue navigation, public access, and aesthetics to allow for the expansion of boating and other recreational and/or tourism opportunities;
- Maintain one-percent flood protection in Alviso Slough;
- Reduce mosquito nuisance; and

- Promote the integration of the Alviso Slough Restoration project with the South Bay Salt Pond (SBSP) Restoration Project (including the SBSP Phase 1 Action at Pond A8) to re-establish the saltwater connection to the Lower Guadalupe River.

Project Alternatives

Following a thorough review of a range of potential actions, six feasible alternatives (each a possible project) were selected for detailed evaluation:

- Alternative 1: Vegetation and Root Mass Removal (2.6 acres) to a 4-foot depth;
- Alternative 2: Vegetation and Root Mass Removal (7.0 acres) to a 4-foot depth;
- Alternative 3: Vegetation and Root Mass Removal and Dredging (3.7 acres) to an 8-foot depth;
- Alternative 4: Vegetation and Root Mass Removal and Dredging (6.2 acres) to a 16-foot depth;
- Alternative 5 (Staff Recommended): Vegetation and Root Mass Removal (15.3 acres) to a 4-foot depth + additional area for Dredging (9.7 acres) to a 10-foot depth; and
- Alternative 6: No Project.

Public Outreach

Community feedback and support for project alternatives have been actively sought during the planning phase of this project. As part of the collaborative agreement, the District has worked extensively with Alviso community members over the past several years. District staff has attended monthly meetings of the Alviso Water Task Force in Alviso to provide project progress updates and engage the community in the project development process. Staff has also met with regulatory agencies to obtain their input and support for the project. In March and August, 2007, the District held public meetings to which the greater Alviso community was invited, to present project alternatives and to solicit comments on environmental issues to be addressed in the project's Environmental Impact Report (EIR). In June 2008 the Draft EIR and Draft Engineer's Report were released for public review. A public hearing on both reports was held in Alviso on July 16, 2008.

Staff-Recommended Alternative

In the May 2008 Draft Engineer's Report, staff had identified Alternative 5 as the recommended alternative based on the project objectives, engagement with the local community, and feedback obtained from the public meetings held to date. Alternative 5 best met all the project objectives

Several comment letters from various regulatory agencies submitted during the public review period for the Draft EIR raised concerns about 1) the initial and ongoing disturbance to habitat from regular maintenance dredging and vegetation removal; 2) disturbance and potential migration of mercury-contaminated sediments by both the initial project work and long-term maintenance activities; and 3) potential uptake of exposed contaminated sediment by the biota.

Some stakeholder groups also expressed concerns about the environmental impacts of the proposed project, and the financial and schedule impacts to other District projects or programs if both the initial capital investment and long-term maintenance funds would be appropriated for the proposed project.

Revised Staff-Recommended Alternative

Based on the comments received on the Draft EIR and subsequent meetings held with several resource agencies, staff is revising the recommended alternative from Alternative 5 to Alternative 3. As shown in Figure ES-1, Alternative 3 would include vegetation and root mass removal over 3.7 acres, and dredging within that same footprint to a depth of 8 feet. This alternative was originally developed with the purpose of balancing the extent of environmental impacts and costs, yet still meeting overall project objectives. The project work is proposed along the east side of the slough from approximately 600 feet downstream of the UPRR Bridge to the Alviso Marina County Park. The project would improve access and boating and navigation opportunities and would assist the operation of the South Bay Salt Pond Restoration Project's Phase 1 Action in Pond A8 (Pond A8 Notch). Notch operations are anticipated to naturally widen and deepen the slough over a period of years through tidally-induced scour, and thus increase flow conveyance capacity of the entire slough from Alviso to San Francisco Bay.

Before-and-after photo simulations of the revised staff-recommended alternative are shown in Figure ES-2. Using an aerial photo taken of the slough area in February 2005 during a low tide, the "before" photo provides a dotted outline of the proposed extent of vegetation and root mass removal and sediment dredging. The "after" photo provides a simulated view of post-project conditions at low tide.

The staff-recommended alternative would include the removal of debris from the Project Area, including abandoned vessels, unused docks, and sunken vessels, if not already resolved by the Bay Conservation and Development Commission (BCDC), California State Lands Commission (CSLC), the District, and the South Bay Yacht Club (SBYC).

Mechanical removal of vegetation/root mass, and the increase of the channel cross-section area from dredging, would increase the flow capacity of the slough in the Project area, but would not change the channel flow capacity in portions of the slough downstream of the County Marina. During high flood events, this difference in channel capacities could result in higher flows being conveyed to the slough sections downstream of the County Marina. Such flows could overbank the levees along the east side of the slough between the County Marina and the Bay, and threaten the Alviso community by flooding the salt ponds and New Chicago Marsh just north of Alviso.

To mitigate for this impact, the staff-recommended alternative would include lowering the Pond A8 weir (Fig. ES-1) by 1.3 feet over a length of about 200 feet. This would maintain the existing flow split between overflows to Pond A8 and flows conveyed along Alviso Slough to the Bay, as engineered by the recent Lower Guadalupe River Flood Protection Project, and would maintain 1 percent flood protection for the Alviso community.

Phased Approach to Implementing Staff-Recommended Alternative

For the Alternative 3 proposed project, staff is also recommending that the work be phased over a period of time. By the end of summer 2010, the Pond A8 Notch construction is anticipated to be completed, and the notch is expected to begin operating in spring 2011. Staff recommends that a portion of the 3.7-acre footprint of the proposed Alternative 3 slough restoration project be cleared of vegetation and dredged to a depth of 8 feet in 2012, one year after the Pond A8 Notch operations begin. Depending on the extent of observed channel scour after the initial portion of work, the District would determine locations where additional mechanical removal of vegetation and root mass, and sediment dredging, would best assist the action of the notch to gradually widen and deepen the slough. Removing vegetation or dredging on just a portion of the proposed Alternative 3 footprint would be less costly and, over the long term, may be less environmentally intrusive.

Estimated Project Cost

Table ES-1 provides a summary of design, construction, mitigation, and operations and maintenance costs if the staff-recommended alternative is 1) fully implemented (clearing and dredging over the full 3.7 acres); and 2) partially implemented (clearing and dredging 1 acre of the Project area). The capital cost for the 3.7-acre project would be approximately $6.2 million if dredged sediments can be disposed of at a local landfill. If sediment sampling conducted prior to construction indicates that sediments are highly contaminated with mercury, Polychlorinated biphenyls (PCBs), metals, or other legacy contaminants, the sediments may have to be transported to a special disposal facility, which could increase the capital cost to approximately $12 million.

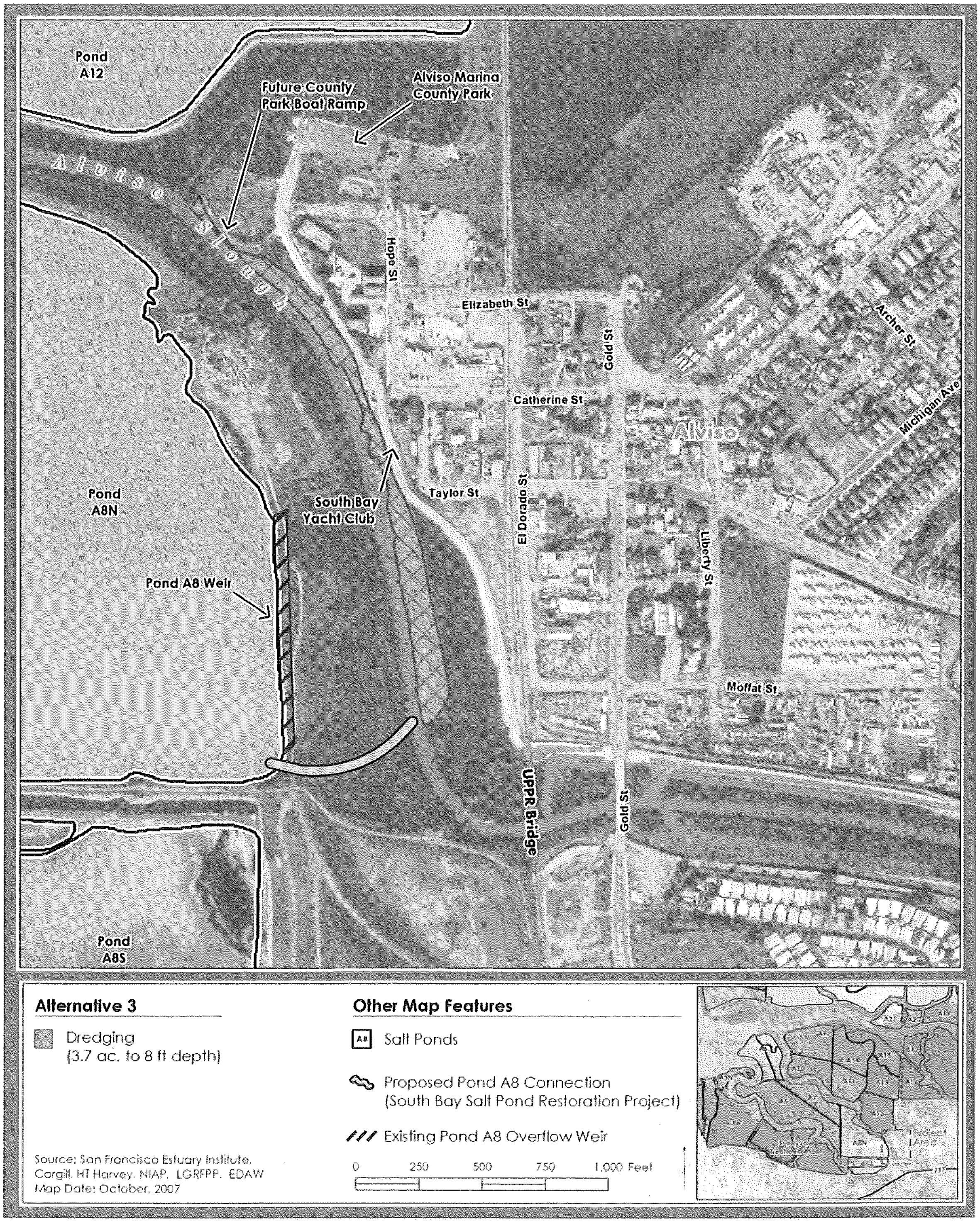
If only 1 acre of the Project area is cleared and dredged, the estimated capital cost for this first phase of work would range from $2.4 million to $4 million. Over time, additional phases of clearing and dredging may be warranted to best align with the natural channel scour from the Pond A8 Notch operations.

Local beneficial re-use of the dredged sediment could reduce the trucking and disposal fees. The sediment characterization from pre-construction sampling will determine the existing sediment quality data in the Project area, to determine if it is suitable for re-use applications.

Long-Term Maintenance Costs

Table ES-1 also provides an estimate of annual maintenance costs for the full 3.7-acre proposed project over the first 10 years after project implementation. Given that sedimentation in this reach of the slough will continue, both from incoming tidal deposits and flows from upstream, the dredged Project area will refill with sediment. It is estimated that sediment dredging would be required three times in a 10-year maintenance cycle to maintain the width and depth of the Project area. If the Pond A8 Notch operation is successful, the long-term maintenance costs for the staff-recommended alternative would be reduced.

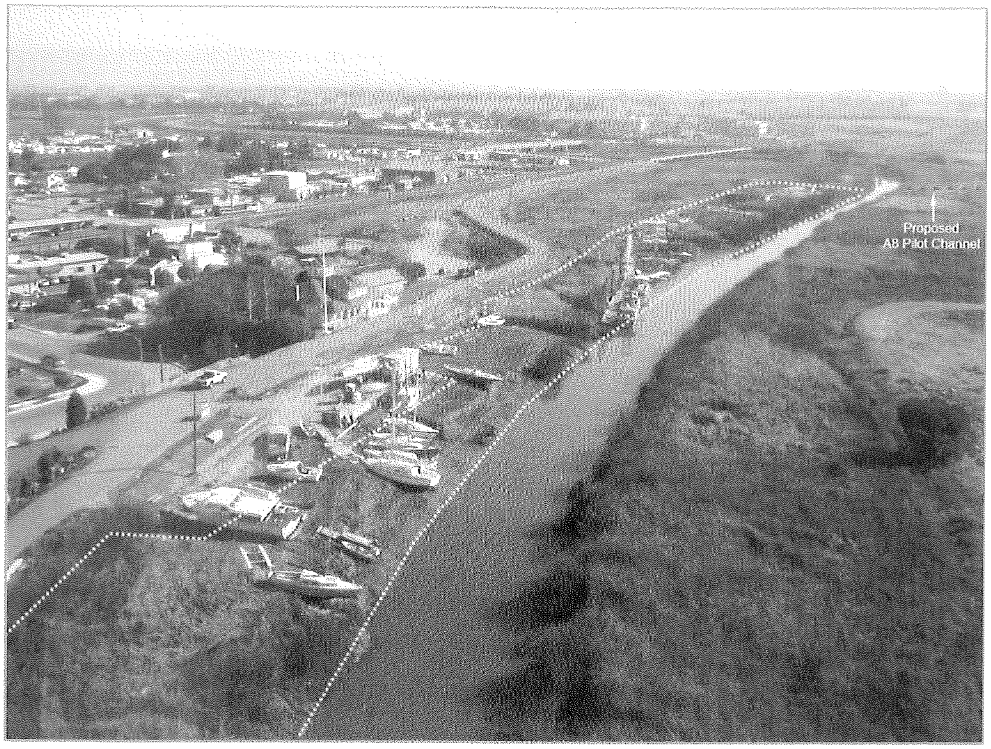
If the proposed Project is implemented in phases, the long-term maintenance costs would be determined based on the level of sustained channel scour from Pond A8 Notch operations.



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: October, 2007

Figure ES-1. Alternative 3: 3.7 Acres of Vegetation and Root Mass Removal and Dredging to to 8-foot Depth

Before: Dotted lines show outline of proposed vegetation/root mass removal for Alternative 3.



After: Even at low tide, dredged areas will have adequate depth for 2-way boat traffic.

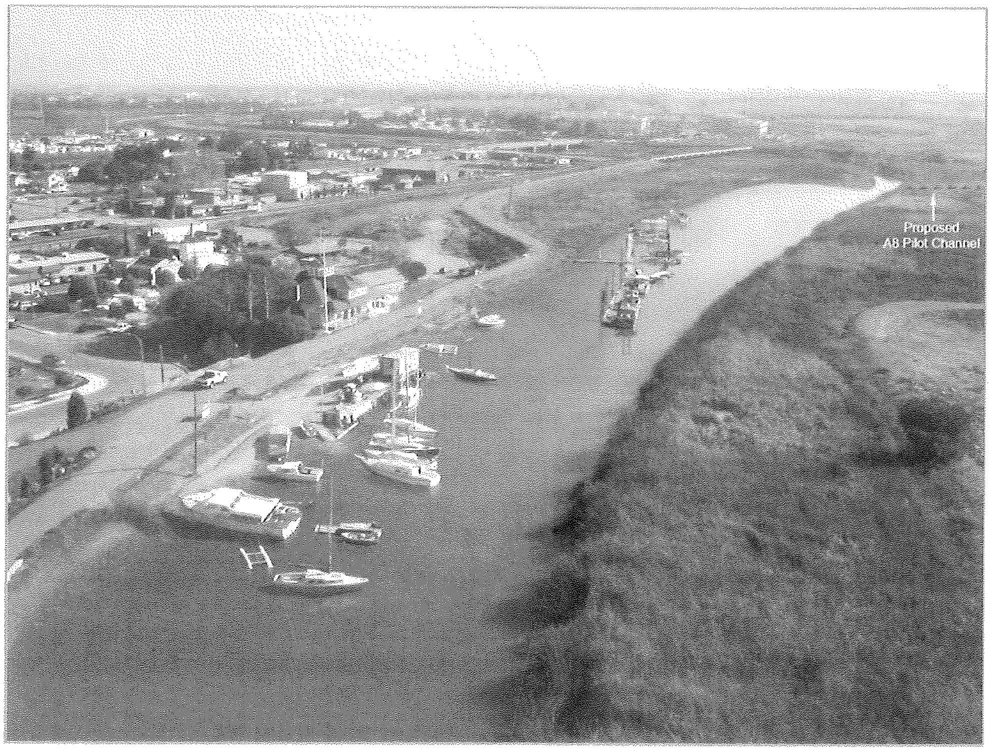


**Figure ES-2. Alternative 3: 3.7 acres of Dredging to 8 ft. Depth
Before and After Visual Simulation**

Table ES-1. Estimated Capital and 10-Year O&M Costs for Alternative 3

Alternative 3 Project Elements		Preliminary Capital Cost to Dredge 3.7 Acres	Preliminary Capital Cost for Phased (1 acre) Implementation
	Design and permit negotiations	$500,000	$500,000
A	Pre-construction biological surveys and sampling	$0.15M-$0.2M	$100,000
B	Clearing/grading of staging areas	$50,000	$20,000
C	Dredging and stockpiling	$444,000	$120,000
D	Biological monitoring during construction	$50,000	$25,000
E	Trucking/disposal of vegetation and root mass	$369,000	$100,000
F	Trucking/disposal of dredged sediment	$2.4M - $7.2M	$0.6M - $1.9M
G	Removal of debris/abandoned vessels	$250,000	$250,000
H	Modification of Pond A8 Weir	$150,000	$50,000
I	Mitigation Costs (2:1 replacement ratio @ $100K/acre)	$740,000	$200,000
	Subtotal (design and construction)	**$5.2M – $10M**	**$2M - $3.3M**
	Contingency (20%)	$1M - $2.0M	$0.4M - $0.7M
	ESTIMATED TOTAL CAPITAL COST	**$6.2M - $12.0M**	**$2.4M - $4M**
	Annual O&M Costs: (A, C, D, and F every 3 years over 10-yr period)	$1M - $2.4M	To be determined based on Pond A8 Notch operations
	Contingency (20%)	$0.2M - $0.5M	
	ESTIMATED ANNUAL O&M COST	**$1.2M - $2.9M**	

Significant Environmental Impacts and Mitigation

Although design work for this effort will be fairly minimal, obtaining permits from various regulatory agencies will be challenging due to the project's identified environmental impacts, detailed in the project's Environmental Impact Report (EIR) (EDAW 2009). As stated earlier, a phased approach to project work in tandem with the operations of the Pond A8 Notch, would possibly reduce the extent of some impacts. If the project work extends over the full 3.7 acres, it is anticipated that the required off-site mitigation for loss of wetlands would be approximately 7.4 acres (2:1 mitigation ratio).

Project Financing

The proposed project would be financed by the Watershed and Stream Stewardship Fund. If the proposed project work extends over the full 3.7 acres, between $1 million and $3 million may have to be set aside annually from property tax revenues to fund periodic dredging of the slough channel to maintain post-project conditions. This is a conservative estimate; if the proposed Pond A8 Phase 1 Action is operated successfully and the project implementation is phased over a period of time, the long-term maintenance costs for the Alviso Slough Restoration Project would be reduced.

Implementation of Staff-Recommended Project

If the Board of Directors elects to fund the staff-recommended alternative for the Alviso Slough Restoration Project, the following milestones have been developed as the next steps toward project implementation:

- EIR certification and Engineer's Report approval: November 2009
- Completion of permit acquisition: July 2011
- Slough restoration – no phasing: June 2012
- Phased slough restoration: June 2012 and later dates to be determined

If the project is approved, negotiations for necessary permits would begin in 2010 and could take 12 to 18 months to complete. With the Pond A8 Notch construction slated for completion in 2010, the notch operations would begin in spring 2011. The first phase of vegetation removal and dredging is recommended to be performed in June 2012, and be repeated in later years, as necessary, based on the success of the Pond A8 Notch operations. Chapter 5, "Recommended Alternative – Description of Work" provides a more detailed description of how the slough restoration work would progress.

Chapter 1
Introduction

1.1 Alviso Slough History

The community of Alviso is located along the edge of San Francisco Bay, 7 miles northwest of downtown San Jose, in the natural floodplains of two major watercourses, Coyote Creek and the Guadalupe River (Figure 1-1). Alviso was consolidated with the city of San Jose in 1968. Alviso Slough now functions as the tidal slough channel portion of the Lower Guadalupe River; it is generally defined as the channel section north of Gold Street and is the last reach of the Guadalupe River before it enters the open waters of San Francisco Bay. The river flows north from the Santa Cruz Mountains through downtown San Jose. Today, the neighboring Alviso Marina County Park (County Marina) and former salt ponds, which are part of the Don Edwards San Francisco Bay National Wildlife Refuge, occupy most of the area around Alviso (Figure 1-2).

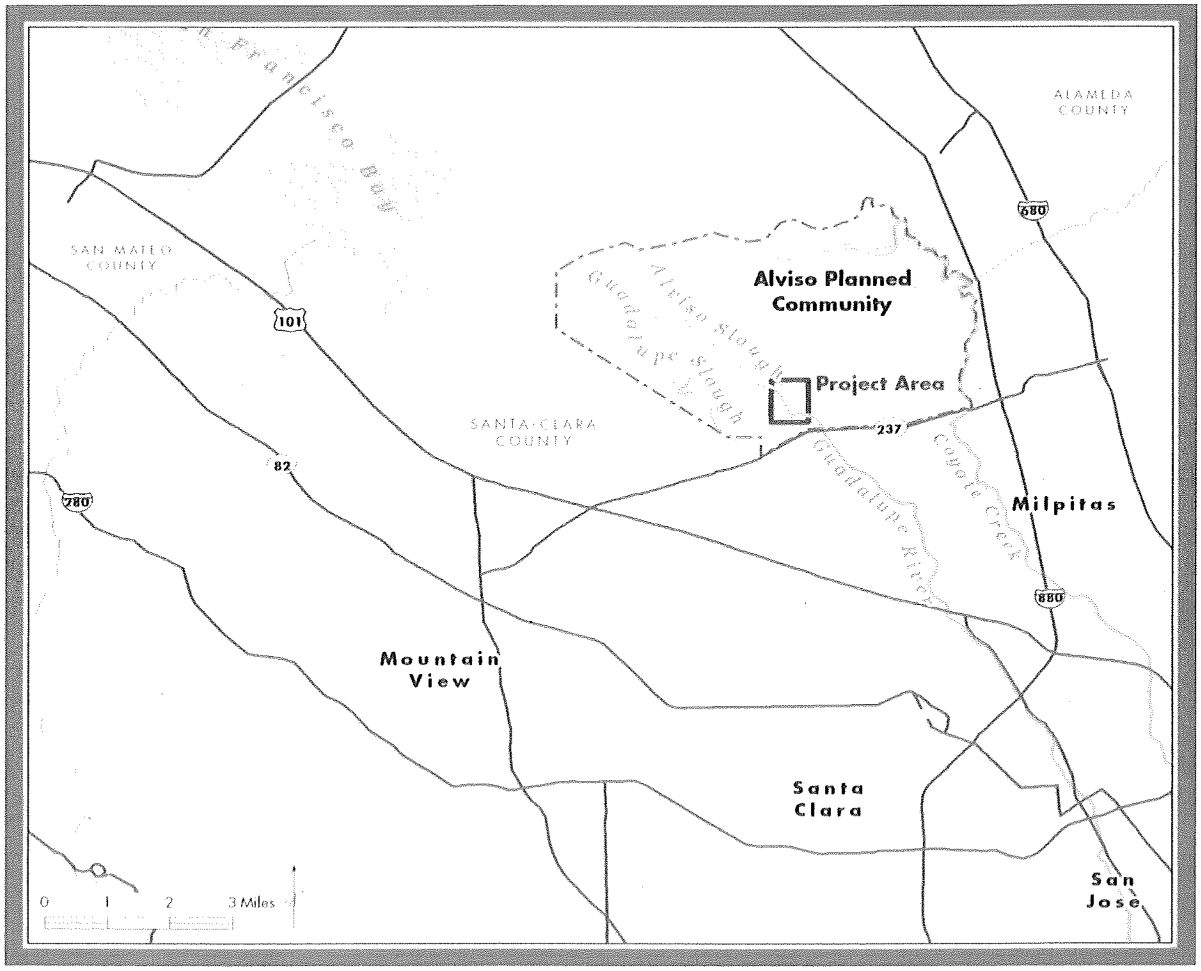
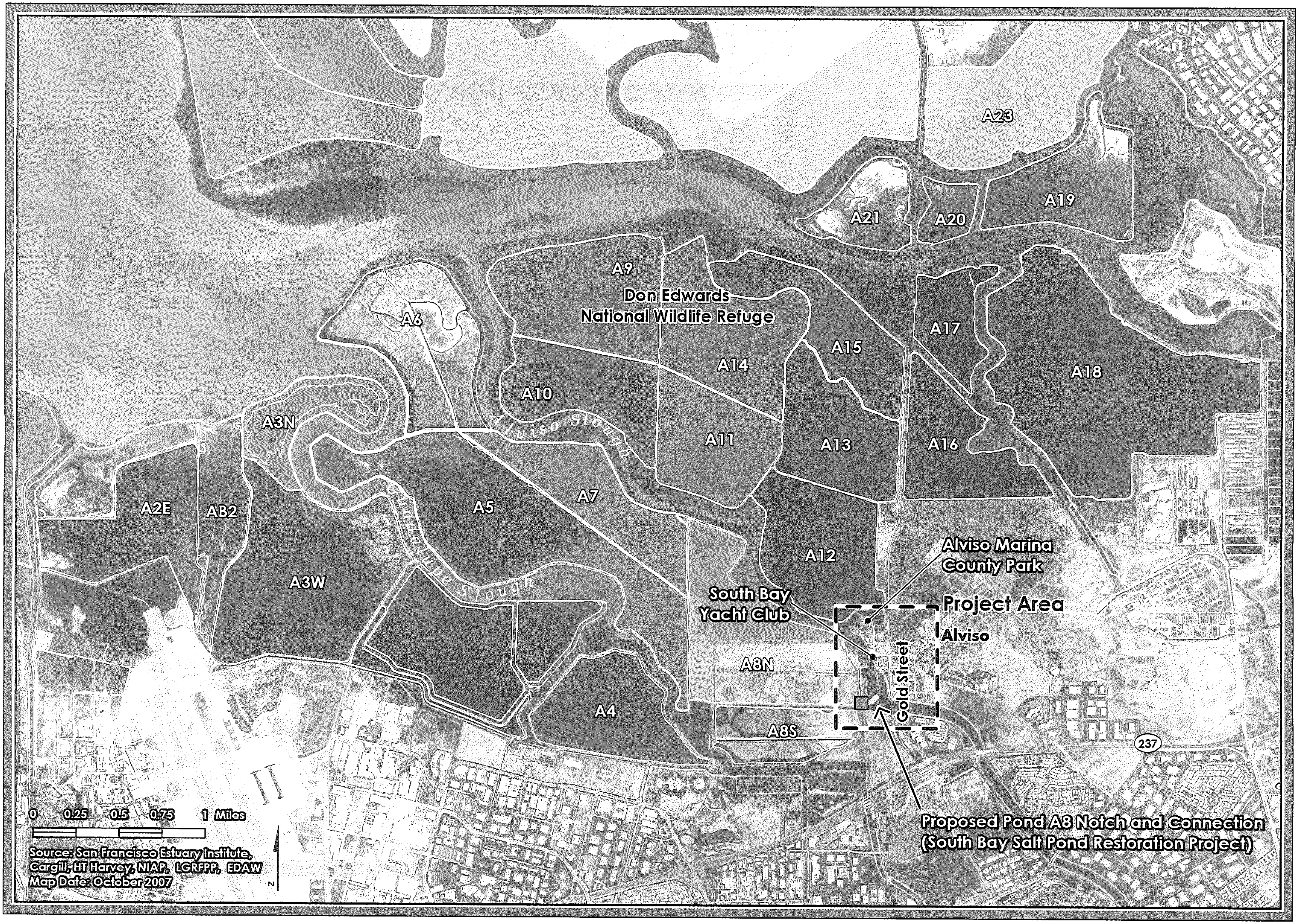


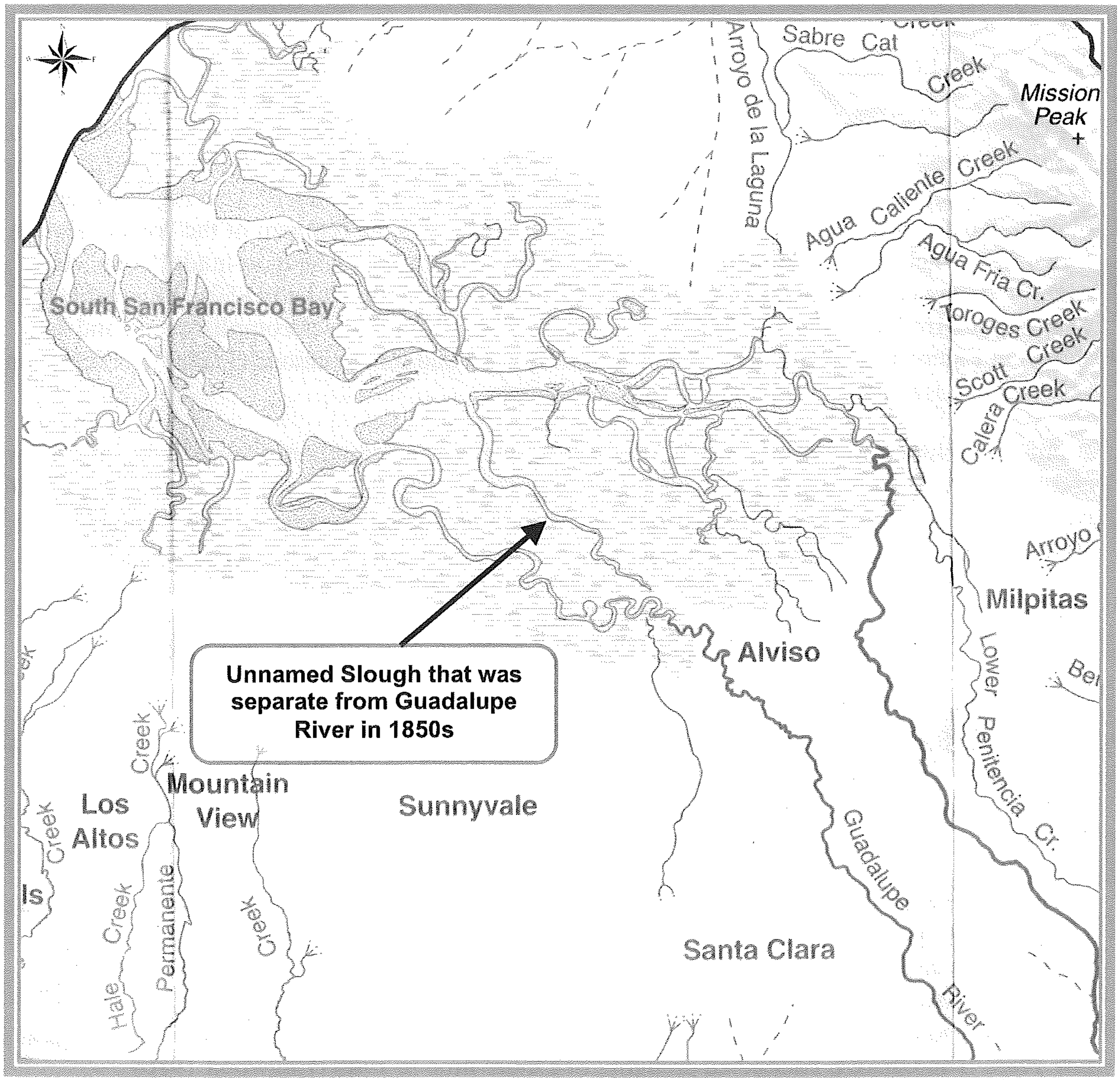
Figure 1-1. Regional Location



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: October 2007

Figure 1-2. Alviso Slough Restoration Project Area Location

Originally inhabited by Ohlone Indians attracted by the bounty of fish and shore birds, the Alviso area was given by land grant in 1838 to Ignacio Alviso, who came as an explorer with Captain Juan Bautista de Anza in 1776. Figure 1-3 shows a portion of the historical (circa 1850) waterscape of the Santa Clara Basin (Sowers, 2005). Of note is the depiction of the Guadalupe River, and the as-then unnamed slough just to its north, as two separate channels. The unnamed slough drained a large area of the South Bay tidal marsh, and its upstream point nearly connected with one of the oxbows of the Guadalupe River.



Unnamed Slough that was separate from Guadalupe River in 1850s

Source: Sowers and Thompson 2005.

Figure 1-3. Historical Waterscape (c. 1850) of the Santa Clara Basin

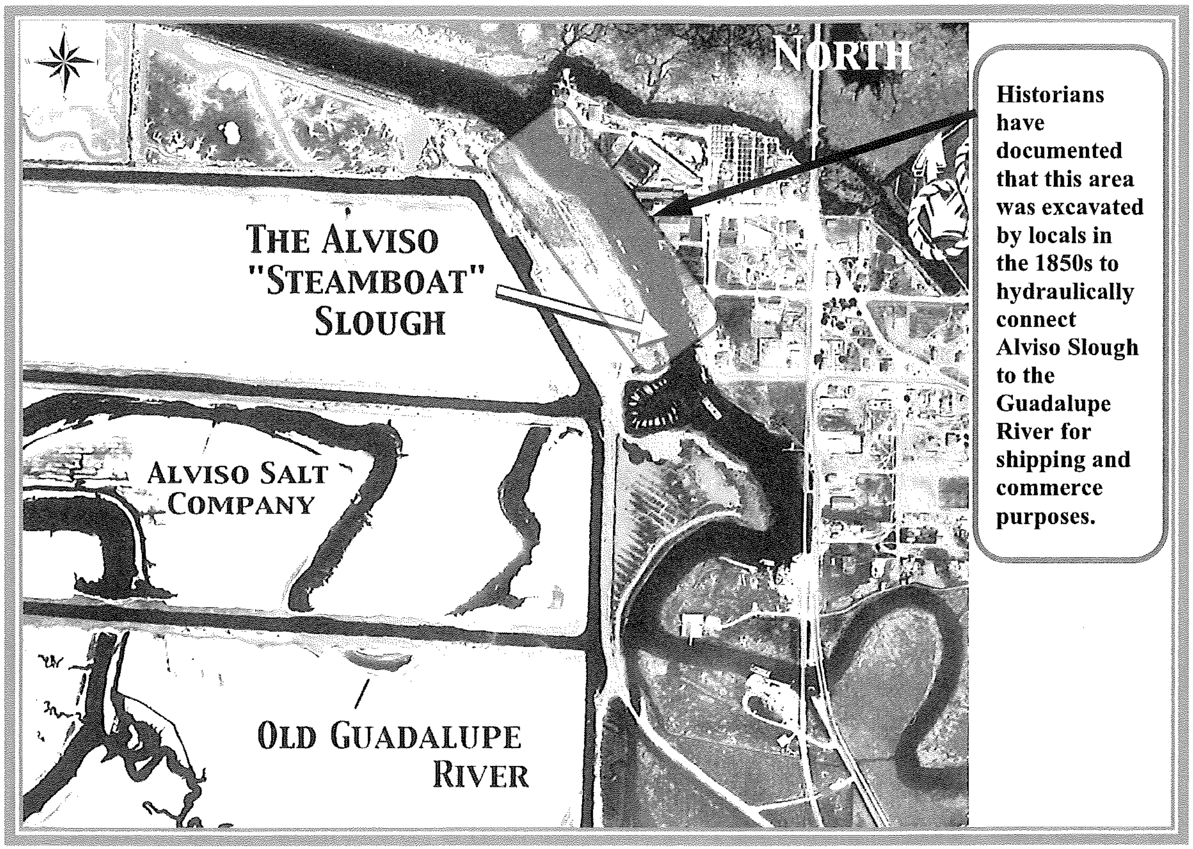
In 1849, the Town of Alviso was laid out by surveyor Chester S. Lymon, and the first steamboat, the *Sacramento*, arrived. Soon, homes, taverns, stores, and hotels sprang up around the busy wharves, and Alviso was crowded with steamboats and stagecoaches. The Town was incorporated in 1852. As the primary water-based connection between San Francisco and San Jose, Alviso became a prosperous port in the mid-1800s, where hides, tallow, grains, redwood, and quicksilver from the New Almaden mines were shipped around the world. Ships would travel from South San Francisco Bay up the Guadalupe Slough to the port known as the Embarcadero de Santa Clara (Burrill et. al., 2006), where goods would be offloaded for conveyance on smaller boats up the Guadalupe River to the then tiny community of San Jose.

According to historians (Burill 2006), in the early 1850s sailors noted that another slough from the Bay extended upstream and ended near the existing port (Burrill 2006). Within a few years, the first human manipulation of the natural waterways in the area was accomplished, when locals excavated a canal between the Guadalupe River and the other slough. Figure 1-4 (Burrill 2006), a 1940s photo, shows the natural sinuous channel of the Guadalupe River weaving to the left through what is now Salt Pond A8. At the top of the photo is the remnant of the "other" slough (Fig. 1-3), which ended just below the anchor seen in Figure 1-4. The man-made "connection" excavated between the Guadalupe River and this other slough in the late 1850s (Munro-Fraser 1881), is referred to in Figure 1-4 as "Steamboat Slough." With this accomplishment, and as shown in Figure 1-5, steamboats could avoid the longer and more sinuous Guadalupe Slough and sail from the Bay up to Alviso via Steamboat Slough.

A late 19th century drawing, Figure 1-5 orients the viewer on Steamboat Slough facing upstream, and shows the Guadalupe River on the upper right flowing downstream towards the viewer, with part of its flow heading to the right off the picture to Guadalupe Slough, and the remainder flowing to the foreground past what was then the port of Alviso. The smaller channel heading from the port to the upper left of the drawing is the original "finger" of Alviso Slough. Historians (Munro-Fraser 1881) noted that the connection of the canal between the Guadalupe River and Steamboat Slough resulted in a greater depth of water in and around the Town of Alviso.

In 1864, the San Francisco-San Jose Railroad – a cheaper and faster alternative to moving goods and people – was completed, bypassing the town and ending Alviso's role as a port of entry for the Santa Clara Valley. In 1876, the narrow-gauge South Pacific Coast Railroad was built and did stop in Alviso, but by then the port use had already declined.

Upon the urgings of residents, the U.S. Army Corps of Engineers (USACE) undertook dredging of the slough up to the Alviso port in early 1900s. Local residents believed that with a better harbor, trade and prosperity would return to the settlement. However, no material increase in volume or character of commerce resulted as a consequence of the improvements, and USACE documents indicate that the dredged portions refilled with newly deposited sediments within a few years. The USACE conducted dredging one more time in 1905 (Hagwood 1980).



Historians have documented that this area was excavated by locals in the 1850s to hydraulically connect Alviso Slough to the Guadalupe River for shipping and commerce purposes.

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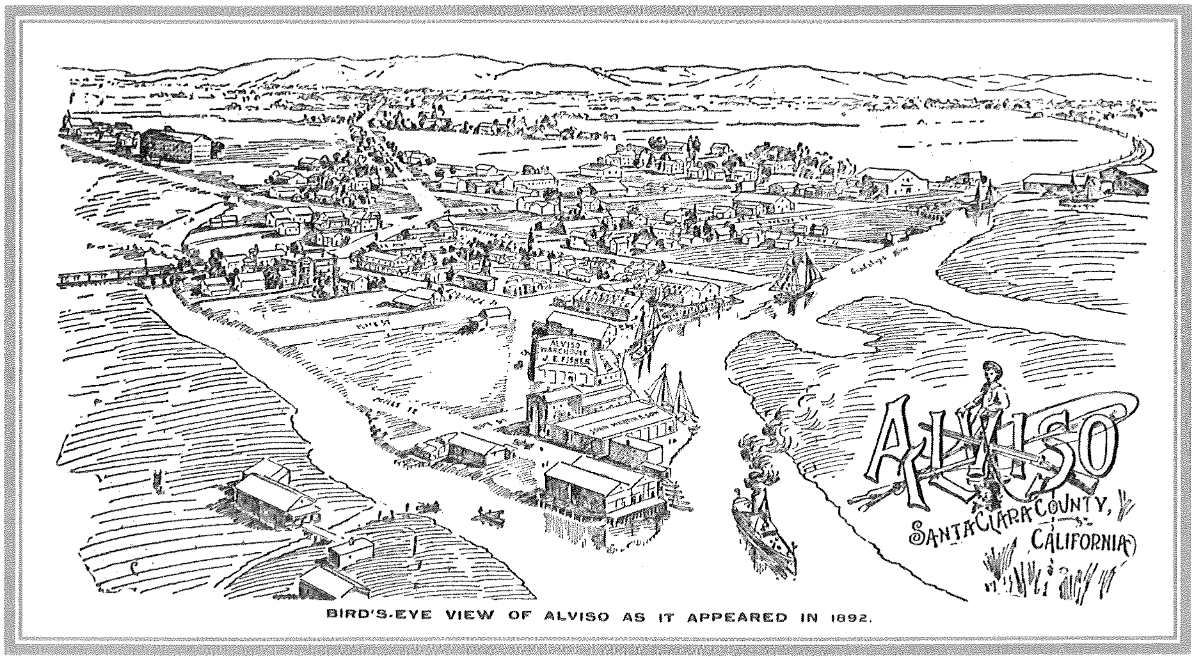
Figure 1-4. Guadalupe River/Steamboat Slough Connection


ALVISO WAREHOUSE J. E. FISHER
ALVISO
SANTA CLARA COUNTY, CALIFORNIA
BIRD'S-EYE VIEW OF ALVISO AS IT APPEARED IN 1892.

Reprinted with permission from *Alviso, San Jose,* *by Robert Burrill and Lynn Rogers, Arcadia publishing, 2006 (www.arcadiapublishing.com).*

Figure 1-5. Town of Alviso, 1892

Figure 1-6 is a historical photo taken in 1915 of the South Bay Yacht Club, constructed adjacent to the slough in 1903. A 1914 photo (Figure 1-7), taken from the Yacht Club, shows a portion of the South Bay Yacht Club Basin, located in a small cove across the slough from the Yacht Club. This cove is likely the same as seen in the 1892 drawing (Figure 1-5), located just downstream of the natural course of the Guadalupe River via Guadalupe Slough. In the background of the photo, a bend of Guadalupe Slough is visible, still conveying part of the flows from the Guadalupe River.

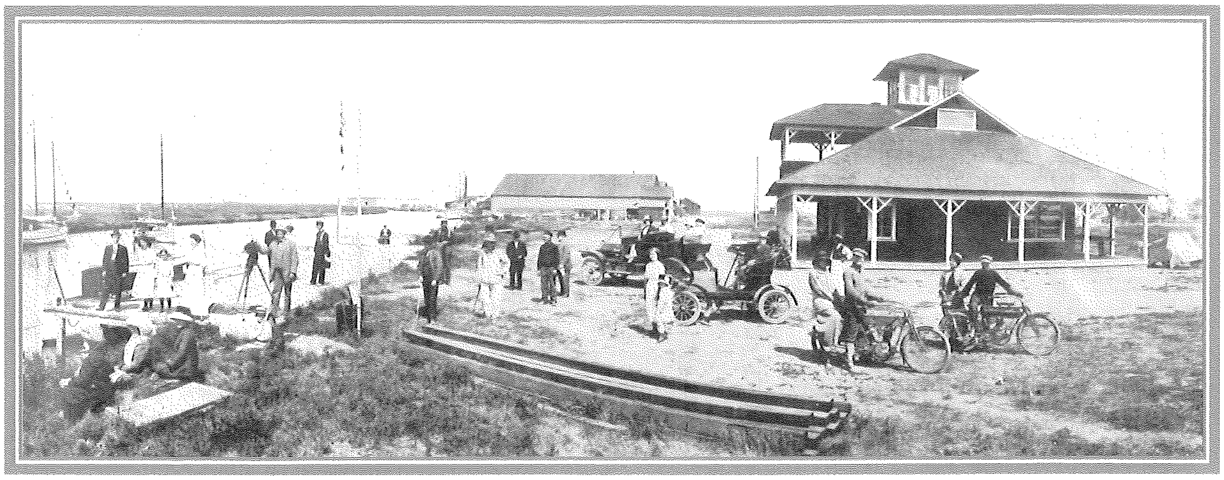
As stated earlier, the natural course of the Guadalupe River flowed northwest, through what is now Pond A8 (Figures 1-3 and 1-4), and entered the Bay through Guadalupe Slough. With the creation of the salt ponds in the 1940s, and in conjunction with early flood control solutions, the Guadalupe River flow to Guadalupe Slough was severed by dikes to create Salt Pond A8. Since that time, the river has flowed only through its mid-19th century man-made connection to the Bay via what has become known as Alviso Slough. Both banks of Alviso Slough were leveed to create the salt ponds in the 1940s. By reducing the area of tidal marsh that drained into Alviso Slough, the salt pond levees also reduced the tidal prism of that channel, thereby reducing the natural scouring action of the channel.

Alviso, as with much of the northern part of San Jose, experienced a gradual land subsidence caused by overpumping of groundwater in the first half of the 20th century. This subsidence added to the town's flooding problems and required the construction of higher levees to protect the town from flooding during large storms. Non-engineered salt pond levees were maintained by Cargill (and other salt production companies before it) to protect its industrial interests, which, incidentally, also benefited Alviso, as the levees provide a physical barrier to tidal flooding.

1.2 Alviso Flooding and Flood Protection Work

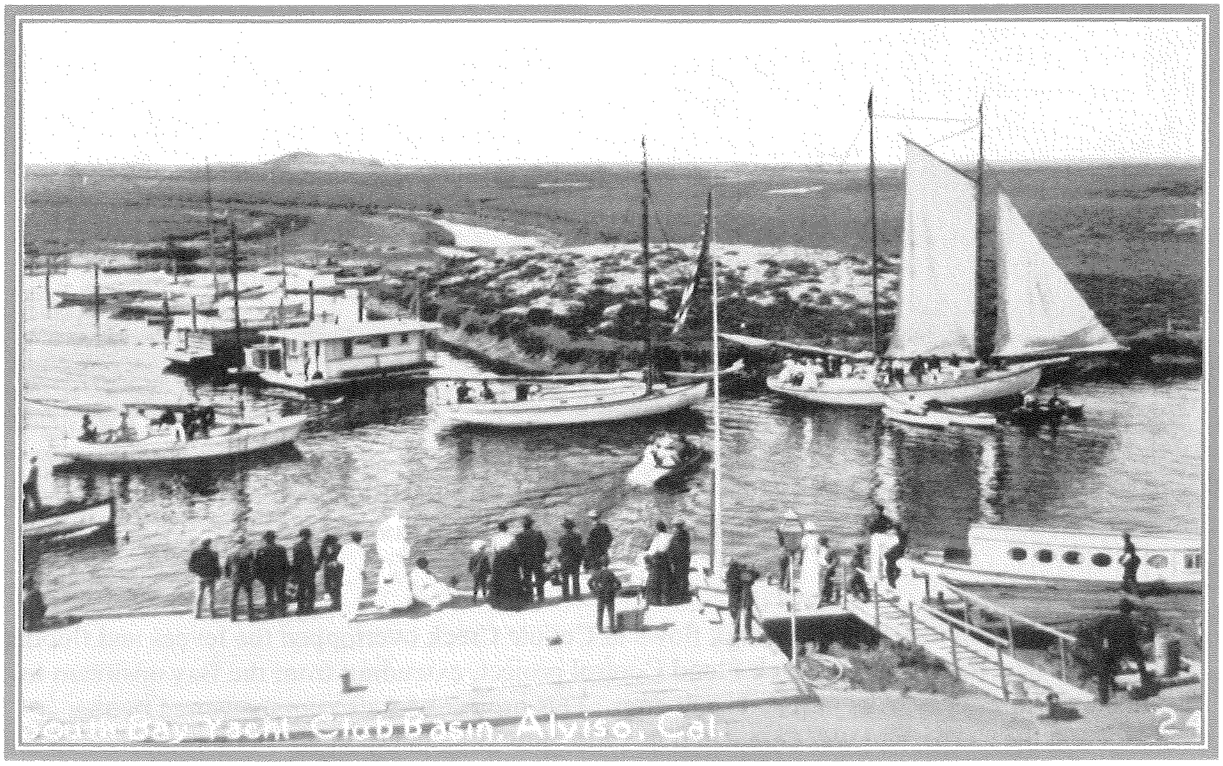
In the early 1960s, the District, then known as the Santa Clara County Flood Control and Water Conservation District, planned a joint effort with the U.S. Army Corps of Engineers to improve the Guadalupe River along an 18-mile corridor from the Bay upstream to Branham Lane. In the Alviso area, existing levees were raised, and the channel was realigned (straightened), from below the UPRR Bridge to upstream of the Tasman Avenue Bridge (SCVWD 1960). Figure 1-8 provides a 1940's aerial photo of the river's historical channel configuration—a black ribbon meandering through mostly agricultural areas from the photo's bottom right to upper left corners. The Project area is located at the upper left of this photo. Superimposed on the photo is the Guadalupe River alignment as surveyed in 1979, and the alignment of several major roads (i.e. North First Street, Gold Street, Highway 237). The Guadalupe River realignment was consistent with the accepted methodology of the 1960s and 1970s -- that a straight, engineered channel would more effectively convey high flows through a river system, thus reducing flood hazards. The modifications, however, limited the river's ability to release overflows to a natural floodplain, which reduced its sediment transport capacity and destabilized the river system.

District maintenance records indicate that minimal vegetation and/or sediment removal work was performed by staff between the Gold Street Bridge and the Alviso County Marina in the decades following the mid-1960's improvement project.



Reprinted with permission from Alviso, San Jose, by Robert Burrill and Lynn Rogers, Arcadia publishing, 2006 (www.arcadiapublishing.com).

Figure 1-6. South Bay Yacht Club, 1915



Reprinted with permission from Alviso, San Jose, by Robert Burrill and Lynn Rogers, Arcadia publishing, 2006 (www.arcadiapublishing.com).

Figure 1-7. Partial View of South Bay Yacht Club Basin, 1914

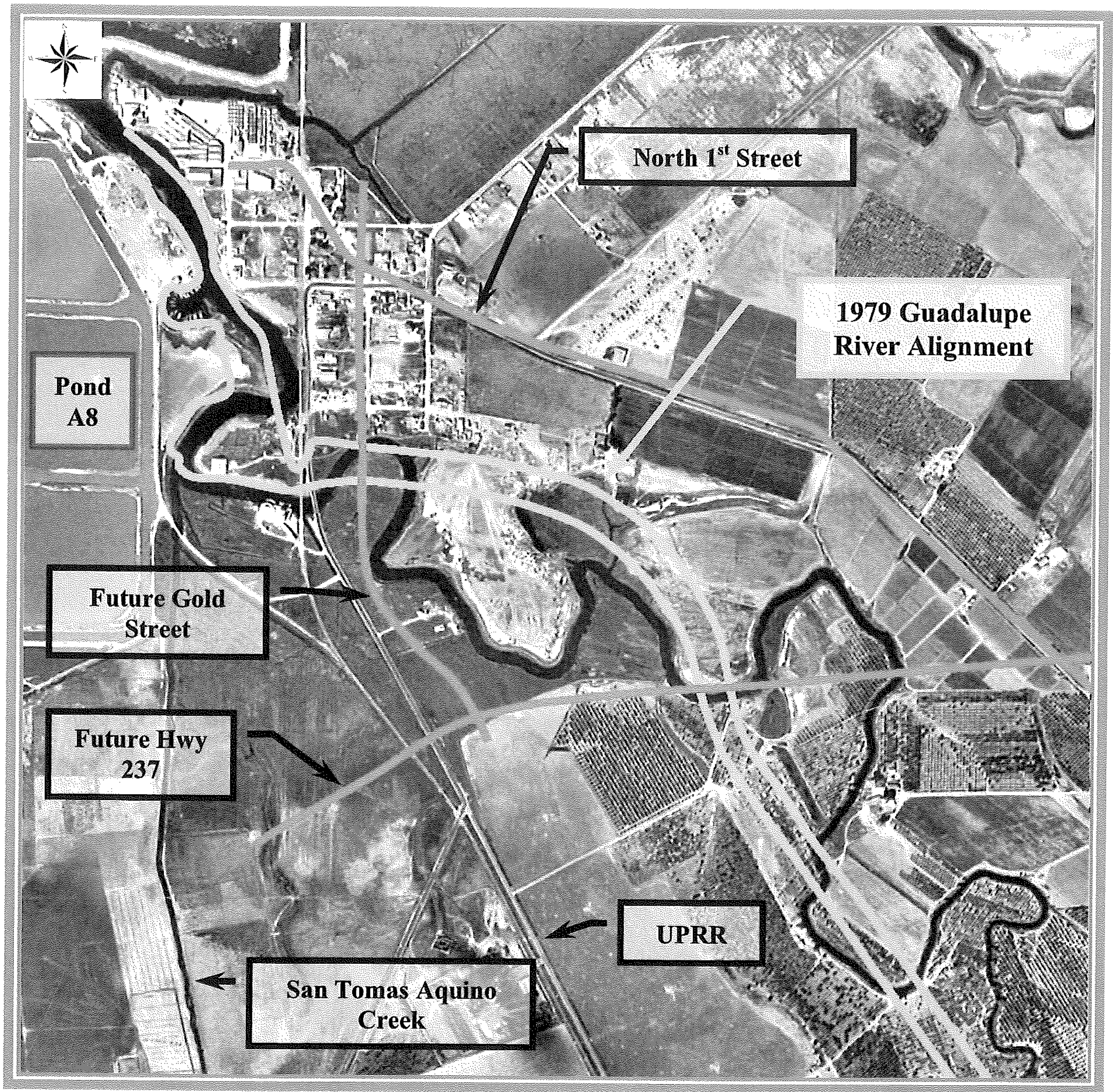


Photo reprinted with permission from *Alviso, San Jose,* *by Robert Burrill and Lynn Rogers, Arcadia publishing, 2006 (www.arcadiapublishing.com).*

Figure 1-8. 1940's Aerial Photograph Showing Historic and Realigned Guadalupe River Channel

Alviso was flooded in 1983, when high flows in Coyote Creek overtopped the levees and flooded the town. The Lower Coyote Creek Flood Control project, extending from the Bay upstream to Montague Expressway, was initiated soon after. This project was also co-sponsored by the District and the Corps, and was completed in 1996, providing one-percent flood protection to this reach of Coyote Creek.

In the mid- to late 1980s the District replaced the Gold Street Bridge over the Guadalupe River and raised levees on the east bank of the river to provide additional flood protection to the town.

More recent high flow events in March 1995, as well as in January and February, 1998, required flood fighting on the Guadalupe River (Northwest Hydraulic Consultants, 2000). Flood flows during these events did overtop the west levee across from Alviso into the Cargill pond complex. Sandbag levees were constructed by the District at the Alviso County Marina during these events to prevent possible overtopping and flooding of the town.

The District again raised levees on the east bank of Alviso Slough between Gold Street and the Alviso County Marina as part of the 2003-2004 Lower Guadalupe River Flood Protection Project work. Alviso is currently protected from one-percent fluvial, or riverine flooding, but remains susceptible, as do all low coastal areas of the South Bay, to tidal flooding.

1.3 Problem Definition

Alviso Slough has experienced a gradual decline in channel width and overall depth due to sediment accumulation and vegetation encroachment over the past 25 years. These conditions are the cumulative effect of a myriad of human activities in the South Bay marshes and waterways over the past 150 years. In the 1850s, a man-made channel was excavated to connect Guadalupe River to what was then referred to as Steamboat Slough (now known as Alviso Slough). In the 1940s, the South Bay marshlands and drainage channels were manipulated and diked for salt-making (evaporator ponds) and agricultural purposes, severing the Guadalupe River from its natural course to the Bay and constraining the flow of Alviso Slough. Groundwater over-pumping and the resulting land subsidence in the early to mid-20th century, the realignment of the Guadalupe River channel meanders for more efficient flow conveyance in the 1960s and 1970s, and urban development in the watershed further constrained and impacted the natural watercourse of the river and the slough. These anthropogenic influences, combined with natural processes that have attempted to reestablish ecological equilibrium, have resulted in a reduced channel width and depth that affects the historical uses of the slough for navigation and recreational access.

Aerial photos spanning the past 60+ years (Figure 1-9) demonstrate the changes in Alviso Slough's channel width. From 1939 to 2004, the width of the channel at two fixed reference points decreased substantially. The channel width at location A, between Ponds A8 and A11, indicates an overall loss of 230 feet of slough width. The channel width at location B, upstream from location A and between Ponds A8 and A12, shows an overall loss of 93 feet of slough width. Although these aerial photos were taken just downstream of the proposed Project area, they nonetheless demonstrate the gradual shifts in the width of Alviso Slough, including the Project area. The residents of Alviso have corroborated these changes in channel width and the subsequent increase in vegetation over the years. Stories of water skiing in a vegetation-free Alviso Slough in the late 1970s are not uncommon (Rivera 2006).

Figure 1-10 is an April 1983 aerial photo of the Alviso Slough channel between the Gold Street Bridge and the Alviso County Marina. Although, as stated earlier, the District's maintenance records indicate little ongoing work in this portion of the channel during the 1960s, 1970s, and 1980s, in 1983 the slough channel was fairly wide, and vegetation was limited to a fringe on either bank of the slough.

Figure 1-11 depicts the same reach of slough in a more recent aerial photo. When compared to Figure 1-10, it is clear that vegetation encroachment on both banks has significantly reduced the slough's open water width in the past 20 years. Figure 1-12 shows 2005 photos of the slough near the South Bay Yacht Club. If comparing Figure 1-12 to Figure 1-6, it should be noted that the South Bay Yacht Club was raised approximately 13 feet during the District's flood protection improvements along Alviso Slough in the mid-1980s, to compensate both for the subsidence in the Alviso area and the raising of the flood protection levees on the east bank of the slough at that time. The levee shown in Figure 1-12 was raised further as part of the Lower Guadalupe River Flood Protection Project (2002-04).

1.4 Project Background

For many years, members of the Alviso community have requested that the slough be restored to its historical width and depth. On July 8, 2003 District staff submitted, for Board of Directors' consideration, several enhancement opportunities for the Lower Guadalupe River Flood Protection Project (LGRP). One enhancement was removal of aquatic vegetation from Alviso Slough between the South Bay Yacht Club and the Alviso County Marina. The Board directed staff "to study the hydrology between the slough and Pond A8 and come back...with a final report on the feasibility of including vegetation removal in the Alviso Slough as a restoration effort done as part of the scope of a larger project" (SCVWD 2003).

On January 20, 2004 staff submitted, for Board consideration, several items connected to the LGRP; one item proposed to remove aquatic vegetation downstream of the UPRR bridge in a manner similar to maintenance operations upstream of the bridge, where side channels are annually cleared of vegetation to improve flow conveyance and to trap sediment for subsequent removal. The cleared side channels upstream of Gold Street can be seen in the recent aerial photo of Alviso Slough in Figure 1-11. A fringe of vegetation on both sides of the low flow channel must remain intact as per regulatory permits; thus, the excavated side channels are not hydraulically connected to the low flow channel except at certain junctions or during periods of high flow.

At the January 2004 Board meeting, numerous members of the community and public provided testimony on the need for better flood protection, the benefit of improved fisheries in the slough if it were deepened and widened to its historic width, the benefit of improved slough access and recreation for both the community and the greater public, and the need for taking action to balance historical inequities. Ultimately, the Board approved a motion directing staff to "prepare a project that includes the following: Phase 1, removal of 7 acres of vegetation and root mass to a depth of four feet on both banks of the Alviso Slough from the Gold Street Bridge to the County Marina; and then in the following year a long term project related to bringing in salt water" (SCVWD 2004).

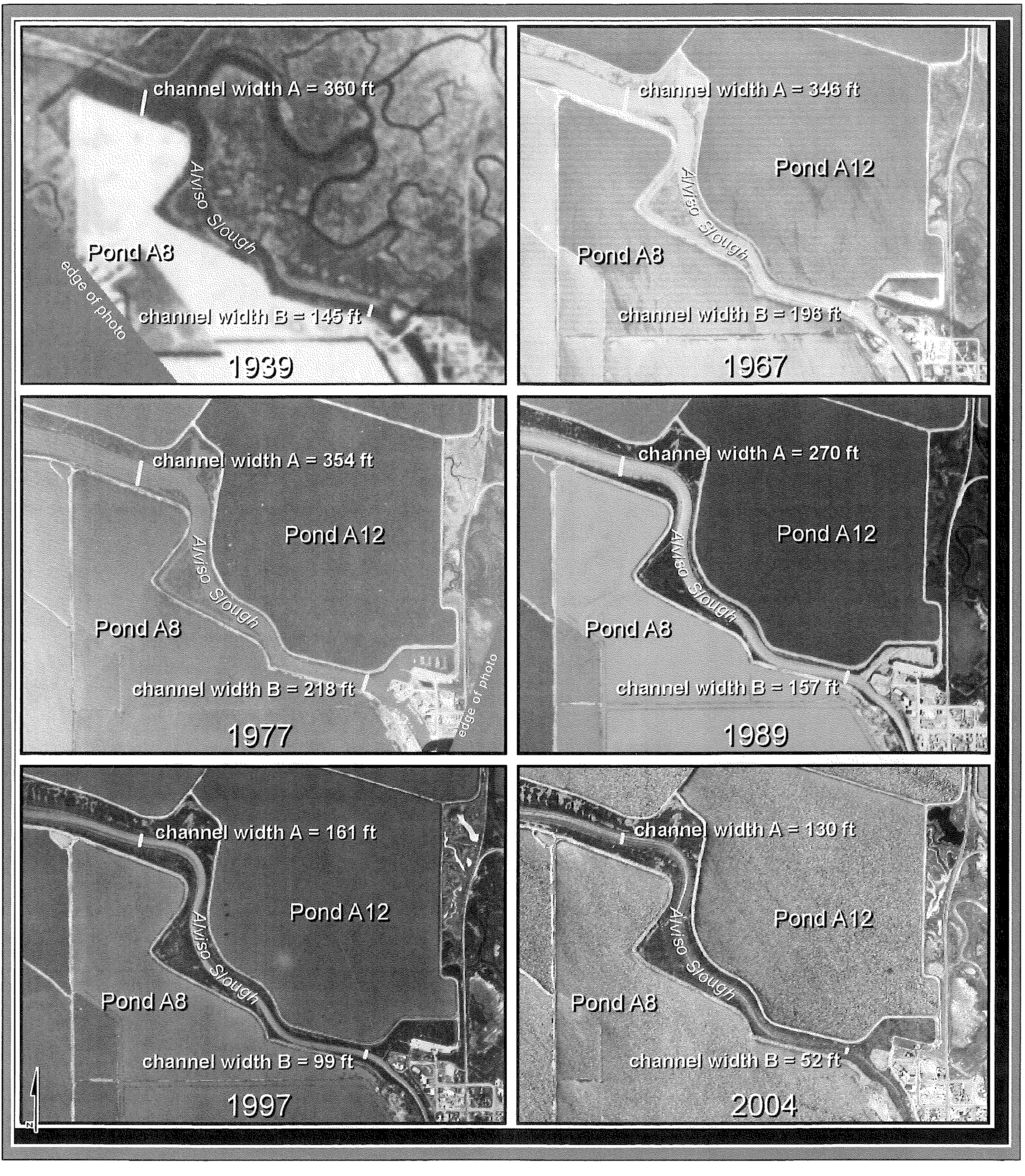


Figure 1-9. Alviso Slough Channel Width, 1939 - 2004

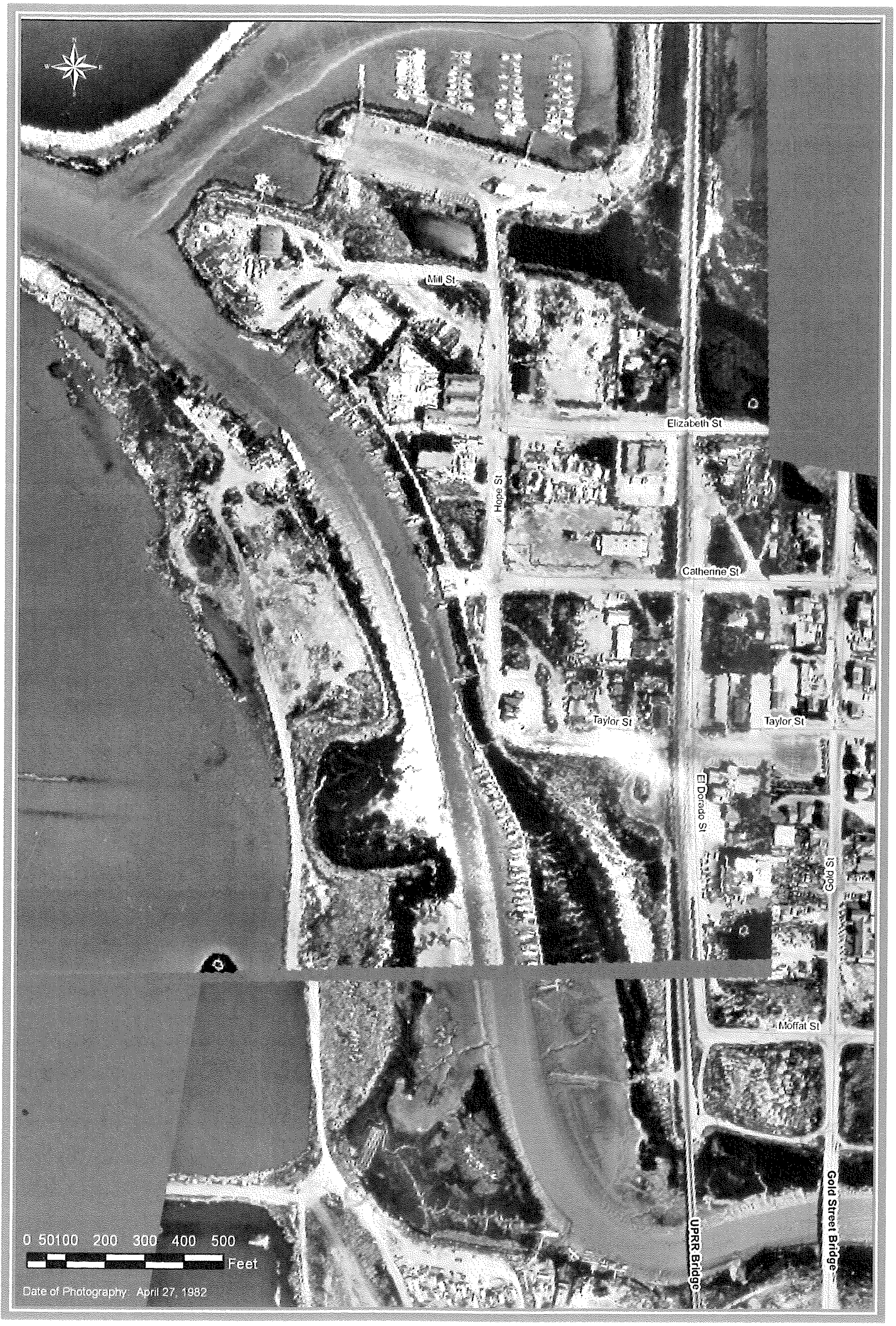
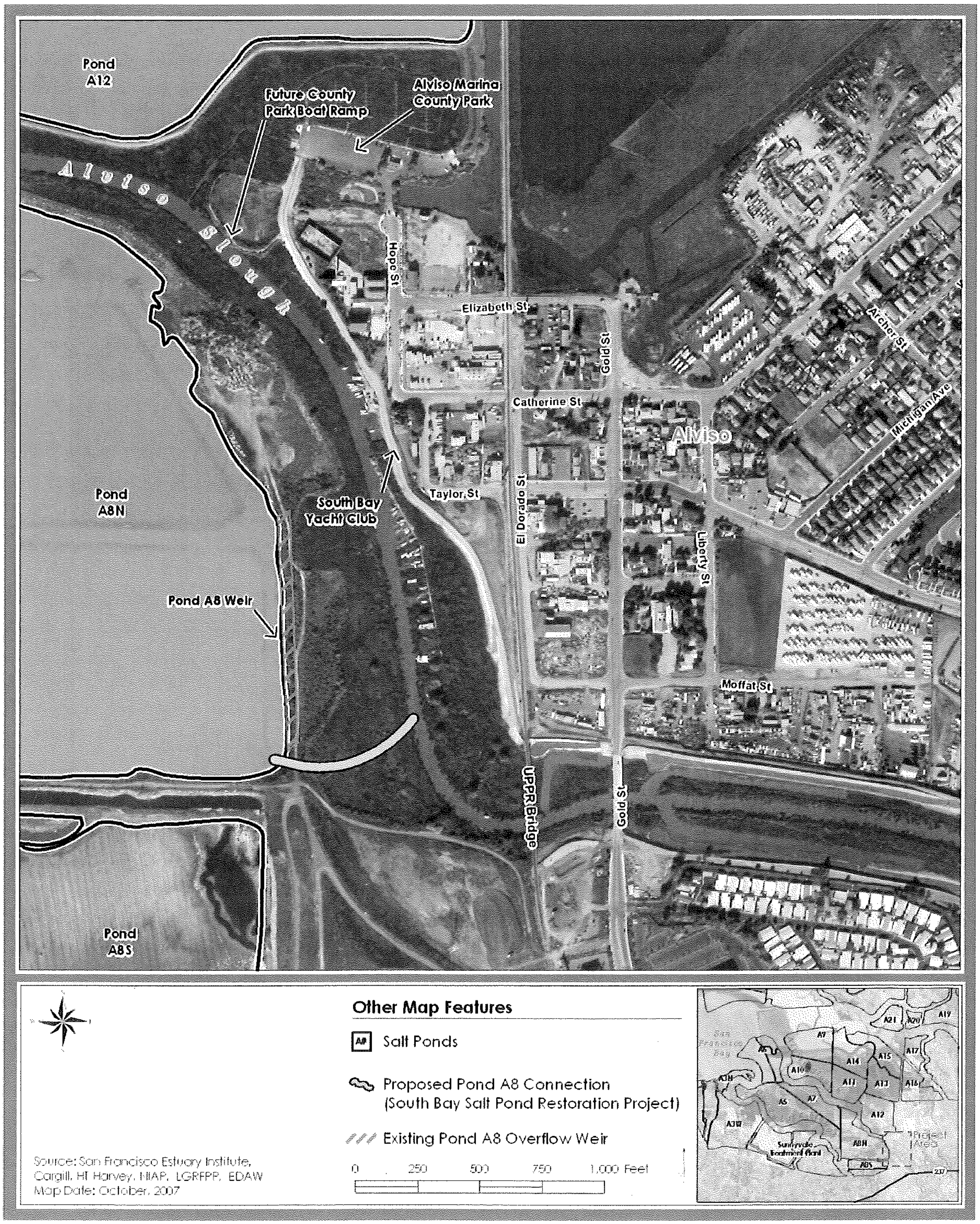
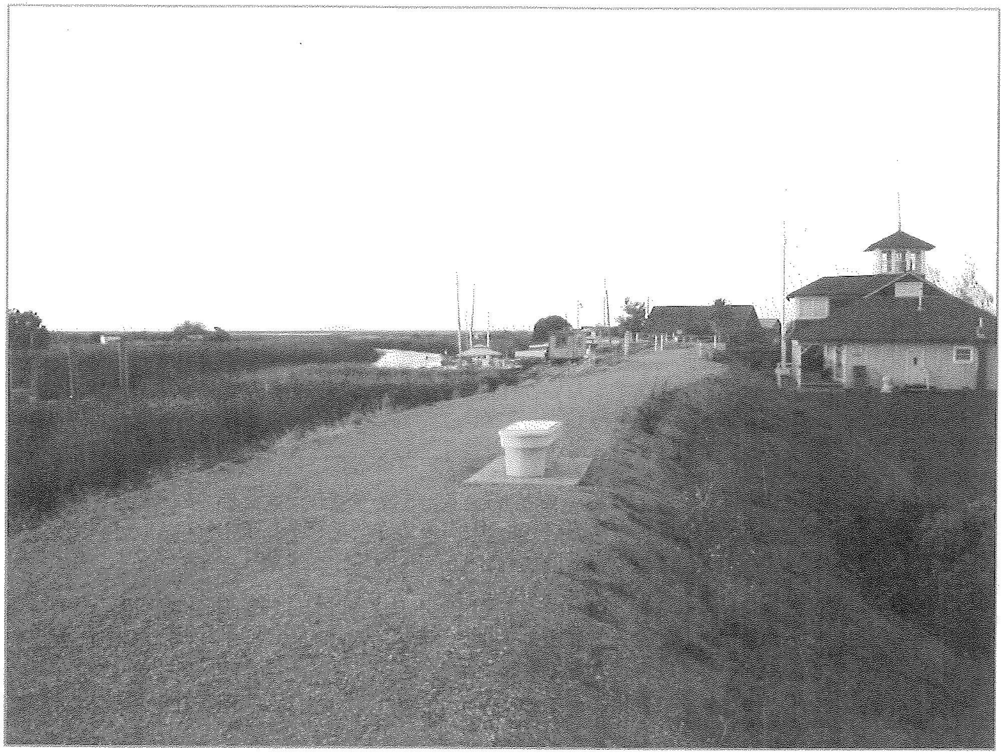


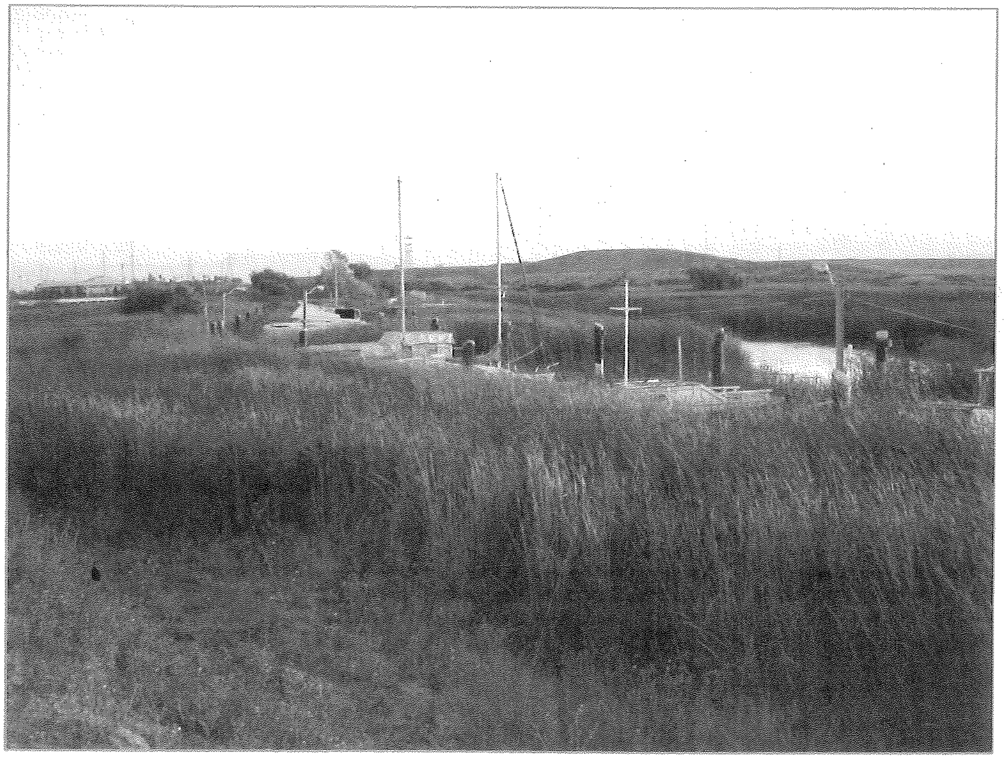
Figure 1-10. April 1982 Aerial Photograph of Alviso Project Area



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: October, 2007

Figure 1-11. 2007 Aerial Photograph of Alviso Slough Project Area





Source: Jim Vogel, EDAW, c.2005.

Figure 1-12. Recent (2005) Photographs of the South Bay Yacht Club and Docks

1.5 Project Objectives

Through most of 2004, staff worked with members of the Alviso community through the Alviso Water Task Force (Task Force) to establish the Alviso and Lower Guadalupe Collaborative, a framework to address both the Task Force and District interests. The Collaborative agreement (Appendix B) was formalized in a signing ceremony in December 2004. Based on the Board directive of January 2004, the following Collaborative project objectives were established:

- Restore Alviso Slough's channel width, and habitat to prior to 1983 conditions (Fig. 1-10);
- Improve the community's ability to pursue navigation, public access, and aesthetics to allow for the expansion of boating and other recreational and/or tourism opportunities;
- Maintain 1 percent flood protection in Alviso Slough;
- Reduce mosquito nuisance; and
- Promote the integration of the Alviso Slough Restoration Project with the South Bay Salt Pond (SBSP) Restoration Project (including the SBSP Phase 1 Action at Pond A8) to re-establish the saltwater connection to the Lower Guadalupe River.

1.6 District Act Authorities

The Santa Clara Valley Water District (District) is a public agency organized under state special district provisions and the Santa Clara Valley Water District Act.[1] The Act establishes a Board of Directors to set policies, determine revenues and expenditures, and monitor the achievement of its purposes. In connection with carrying out water and flood management the District may undertake activities that enhance, protect, and restore streams, riparian corridors, and natural resources.[2]

To this end, the Board of Directors had adopted policies that emphasize the District's commitment to "...an enhanced quality of living in Santa Clara County through watershed stewardship and comprehensive management of water resources in a practical, cost-effective and environmentally -sensitive manner."[3] Specifically, the Board has declared its commitments to fulfill this mission through its Ends policies:

3.2 Environmental Enhancements are implemented to improve watersheds, streams, and the natural resources therein.

3.3 There are additional trails, parks, and open space along creeks and in the watersheds when reasonable and appropriate.

Section 4 of the District Act authorizes the district to provide comprehensive water management for all beneficial uses and protection from flooding within Santa Clara County.[4] Additional language outlines specific actions, such as to obtain, retain, protect, and recycle drainage, stormwater, floodwater, or treated wastewater, or other water from any sources, within or outside the watershed in which the district is located for any beneficial uses within the district[5], and to enhance, protect, and restore streams, riparian corridors, and natural resources in connection with carrying out the purposes set forth in this section.[6] Thus, under Section 4 of the District Act, the District may undertake projects that support or restore beneficial uses of a stream.

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[1] District Act, Chapter 1405 of the Statutes of 1951, as most recently amended by Chapter 279 of the Statutes of 2006.

[2] District Act § 4(c)(7)

[3] Ends Policy 3.1, Governance Policies of the Board of Directors, 1999.

[4] District Act, § 4(a)

The California State Water Resources Control Board prepares Basin Plans that define beneficial uses for water bodies in the state. The San Francisco Bay Regional Water Quality Control Board's (SFRWQCB) Basin Plan defines the beneficial uses for the Guadalupe River as cold and freshwater habitats, wildlife habitat, and non-contact recreational activities.

The Alviso Slough Restoration Project would restore and enhance the beneficial use of non-contact recreational activities. Removing the vegetation and root mass in accordance with the Board of Director's 2004 directive would create more open waters, enhance the natural aesthetics, and incidentally improve recreation access from the shores. It would allow the community of Alviso to return to historic use of the slough.

1.7 Organization of the Engineer's Report

The Engineer's Report includes the following:

- Executive Summary
- Chapter 1. Introduction
- Chapter 2. Project Setting
- Chapter 3. Regulatory Setting
- Chapter 4. Development and Evaluation of Project Alternatives
- Chapter 5. Description of the Recommended Alternative
- Chapter 6. Operation and Maintenance Program
- Chapter 7. Costs and Financing of Staff-Recommended Alternative

In addition to the Engineer's Report, an Environmental Impact Report (EIR) has been prepared to address potential environmental effects of the Alviso Slough Restoration Project. The EIR contains a more detailed discussion of the environmental impacts of the Staff-Recommended Alternative and proposed mitigation measures. The EIR will support decision-making by the District, the U.S. Army Corps of Engineers (USACE), and other responsible and cooperating agencies, to implement the project and ensure compliance with the California Environmental Quality Act (CEQA) and other pertinent laws and regulations. The EIR is bound separately from this Engineer's Report.

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[5] Ibid. § 4(c)(6)

[6] Ibid. § 4(c)(7)

Chapter 2
Project Setting

2.1 Previous Engineering Studies and Related Projects

This section presents summaries of previous projects and related projects in the vicinity of Alviso Slough.

2.1.1 Lower Guadalupe River Flood Protection Project (SCVWD)

In April 2003, the District began construction of the Lower Guadalupe River Flood Protection Project. The intent of this flood protection project was to improve the channel's capacity to convey stormwater runoff up to a 1 percent (100-year) flood event, protect endangered species, preserve fish and migratory bird habitat, and allow for open-space recreation.

The District made flood protection improvements and conducted mitigation planting along 6.5 miles of the Guadalupe River from the Interstate 880 (I-880) bridge north to the County Marina. Project work included: construction of floodwalls or raising levees along the riverbanks; replacement of the Highway 237 eastbound bridge; modification of 19 storm drain outfalls; improvement and construction of maintenance roads and undercrossings; construction of an overflow weir to divert high flows into one of the salt ponds; and construction of grade-control weirs (gradual drops in the stream elevation). The project also featured enhancements, which included providing maintenance roads suitable for use as recreational trails.

Long-term operation and maintenance elements of this project include management of vegetation and sediment from below the Union Pacific Railroad bridge to Highway 237; surveying the slough cross-sections between the Bay and Gold Street every five years to monitor changes to the slough channel conveyance capacity; use of temporary pumps in the salt ponds after major storms to restore capacity following large flow events; and planting and maintaining native vegetation.

2.1.2 Stream Maintenance Program (SCVWD)

The District maintains a Stream Maintenance Program to protect and manage more than 800 miles of streams in the county. As part of this program, the District conducts vegetation maintenance activities, removes built-up sediment from creek channels, shores up eroding creek banks, and removes other impediments. This work not only ensures continued flood protection for homes and businesses but also helps create and maintain stable creek ecosystems.

2.1.3 South Bay Salt Pond Restoration Project (CCC, USFWS, CDFG)

Concurrent with preparation of the EIR for the Alviso Slough Restoration Project, environmental review of the South Bay Salt Pond (SBSP) Restoration Project, led by a consortium of agencies—the California Coastal Conservancy (CCC), U.S. Fish and Wildlife Service (USFWS), and California Department of Fish and Game (CDFG)—has been completed. The combined Final California Environmental Quality Act (CEQA)/National Environmental Policy Act

(NEPA) document—referred to as the *SBSP Restoration Project Final Environmental Impact Statement/Report (EIS/R)*—was issued in December 2007. The USFWS issued its Record of Decision (ROD) for the SBSP Restoration Project on January 30, 2009.

The SBSP EIR/S included specific analysis of proposed initial actions for salt pond restoration, including the Phase 1 Action at Pond A8. Pond A8 is immediately adjacent to the Alviso Slough Restoration Project site and was proposed as one of several locations for initial (Phase 1) implementation of the SBSP Restoration Project.

Construction of the Phase 1 Action at Pond A8 (Pond A8 Notch) is expected to be completed by fall 2010, and will introduce limited tidal action to create approximately 1,400 acres of muted tidal habitat in Ponds A8, A5, and A7. The restoration of tidal action at Pond A8 is designed to be reversible so that, in the event that unacceptable ecological impacts begin to occur, tidal exchange between Pond A8 and Alviso Slough can be eliminated to prevent long-term adverse impacts. Partial restoration of tidal prism in these ponds is expected to induce limited channel scour and increase salinity along Alviso Slough. Over time (1 to 10 years, depending on how the Phase 1 Pond A8 hydraulic structure (notch) is managed), this action would also restore more natural tidal processes that discourage sedimentation and promote scour along the channel of Alviso Slough. These changes could, at least partially, deter the reestablishment of marsh vegetation along the banks of the slough by maintaining a slightly wider channel.

The degree of scouring in Alviso Slough will depend on the ability to maintain or increase the size of the "notch" opening to be constructed under the SBSP Phase 1 Action (Fig. 1-11). The notch will control the flow of water between Pond A8 and Alviso Slough, and has been designed such that it can be closed, opened to a width of 40 feet, or opened to an intermediate width. The width of the notch opening will depend on ecological impacts and potential scour to downstream levees, which will be monitored as part of the SBSP Restoration Project. A wider notch opening at Pond A8 would induce greater scour in the immediate vicinity of Alviso Slough.

Over a longer term (beyond 10 years or more), the SBSP Restoration Project could restore full tidal action to Ponds A8, A5, and A7, if anticipated results from the Phase 1 Action at Pond A8 and associated applied studies are realized. Full tidal restoration, if implemented, is expected to further widen and deepen the slough by increasing tidal flows and thereby increasing scour in the slough.

2.1.4 Alviso Marina County Park Improvement Project (Santa Clara County)

The Santa Clara County Parks Department is currently planning an expansion of the existing Alviso Marina County Park, including a new boat-launching concrete ramp, docking facilities for small non-motorized watercraft such as kayaks and canoes, and a vehicle/trailer parking lot. This project is adjacent to Alviso Slough on a 1.8-acre parcel acquired by Santa Clara County from the federal government (Figure 1-11). Construction of this facility is scheduled for 2009-2010. This launch site is identified as an access point in the 2007 Draft San Francisco Bay Area Water Trail Plan.

2.1.5 South San Francisco Bay Shoreline Study (USACE, SCVWD, CCC, USFWS)

The South San Francisco Bay Shoreline Study is a congressionally authorized study being conducted by the U.S. Army Corps of Engineers (USACE) together with local sponsors. The purpose of the study is to identify and recommend for federal funding one or more projects for flood damage reduction, ecosystem restoration, and related purposes (such as public access). The Shoreline Study is funded through a partnership among the USACE, SCVWD, and the CCC. The USFWS and other land-owning agencies within the Shoreline Study area will also be involved in the planning process.

The study will be performed through several "Interim Feasibility Studies." The first of these interim studies will investigate flood protection for all Santa Clara County baylands, from Palo Alto to Alviso, in addition to the restoration of former salt production ponds within the Alviso Pond complex and adjacent properties, such as areas around Moffett Field.

Various flood protection strategies will be examined, such as increasing the flood capacities of local creeks by widening the mouths of waterways and reestablishing historical floodplains. Although flooding risks from individual creeks have been reduced by a number of existing projects in the area, the Shoreline Study area remains vulnerable to tidal flooding. In Santa Clara County, there are several streams that carry runoff through the valley and north to San Francisco Bay. The two largest rivers—the Guadalupe River and Coyote Creek—have been retrofitted to provide flood protection to most communities along their banks, including the community of Alviso in north San Jose. However, it is the Shoreline Study that will address protection from tidal flooding in these communities.

The USACE completed an initial reconnaissance analysis in September 2004. This analysis determined that a federal flood-control and ecosystem restoration project would likely be justified due to the current and future anticipated conditions in the South Bay. In August 2005, the project partners completed a Project Management Plan to outline how the work would be conducted. On October 24, 2005, the USACE, SCVWD, and CCC kicked off the first phase of the South San Francisco Bay Shoreline Study and are now in the preliminary stages of environmental review. The project is currently undertaking "scoping" to determine the range of environmental issues to be addressed in the alternative development and analysis process.

2.2 Hydrology and Physiography of Alviso Slough

2.2.1 Guadalupe River Watershed

Alviso Slough is the tidal portion of the Lower Guadalupe River, and tidal influence extends approximately 7.5 miles from San Francisco Bay (Bay) to Montague Expressway Bridge (CH2M-Hill 2001). The nontidal Guadalupe River extends upstream from this bridge to its headwaters in the Santa Cruz Mountains. The Guadalupe River watershed encompasses approximately 170 square miles and contains five main tributaries to the river: Los Gatos Creek, Ross Creek, Guadalupe Creek, Alamitos Creek, and Canaos Creek. Basin relief is approximately 3,800 feet, with the highest point near Loma Prieta in the Santa Cruz Mountains and the lowest point near Alviso at the Bay. The basin is characterized by a perimeter of high, steep, natural slopes with a large, wide valley below (CH2M-Hill 2001).

2.2.2 Precipitation

Average annual precipitation varies from 14–16 inches in the lower, urbanized regions of the watershed, to 28–44 inches in the higher, mountainous regions (McKee et al. 2004). Annual runoff in the Lower Guadalupe River for the water years 1971 through 2000 varied from 3 to282 cubic feet per second (cfs), with a daily average of 61.8 cfs (McKee et al. 2004). The majority of runoff (approximately 90%) occurs between November and April. The estimated 100-year flood discharge on the Guadalupe River at Alviso is 18,350 cfs (CH2M-Hill 2001).

2.2.3 Tides

The Guadalupe River, the second largest tributary to South San Francisco Bay in terms of drainage area and flow, discharges to Alviso Slough. The bottom elevation of Alviso Slough ranges from -1 to -3 meters NGVD (National Geodetic Vertical Datum). The tidal range in Alviso Slough is particularly large, with measured high water approximately a factor of 1.6 higher (relative to mean tide) than high water at the Golden Gate Bridge (NMFS 2003). Given the combination of strong tides and shallow depths in Alviso Slough, most of the volume present in Alviso Slough at high water drains to Coyote Creek (and subsequently South San Francisco Bay) during ebb tide. Therefore, this slough—as well as Coyote Creek and Guadalupe Slough—actively exchanges water with South San Francisco Bay due to tidal motions (CDFG 2003).

2.2.4 Historical Evolution of Alviso Slough

Historically, Alviso Slough drained a large area of tidal marsh in the far South Bay. Under natural conditions, the Guadalupe River did not drain to the Bay via Alviso Slough, but rather through Guadalupe Slough. In the late 1850's (Burrill 2006), the locals excavated a canal to join the Guadalupe River to Alviso Slough as a means to more easily access the Bay for commerce and recreational boating. With the construction of the salt pond levees in the 1940s, the Guadalupe River was isolated from its natural course through Guadalupe Slough, and its freshwater flows were conveyed only through Alviso Slough to the Bay. The latter activity more significantly altered the hydrodynamics of both watercourses; it disrupted the equilibrium of the slough by reducing its tidal prism, which allowed freshwater flows to push further down the slough. By reducing the area of tidal marsh that drained into Alviso Slough, the salt pond levees also reduced the tidal prism of that channel, thereby reducing the natural scouring action that had kept the channel open in the past. Subsidence from overpumping of groundwater throughout the San Jose area further exacerbated the no-equilibrium condition of the Guadalupe River/Alviso Slough watercourse, and made Alviso more susceptible to flooding.

2.2.5 Sedimentation

Historical dredging activities in Alviso Slough were conducted by the U.S. Army Corps of Engineers in the early 1900s (Sec. 1-1). The San Francisco Bay Conservation and Development Commission (BCDC) maintains records of three permitted maintenance-dredging events that occurred in Alviso Slough in 1968, 1976, and 1980. The dredge limits for all three dredging events were entirely within the former Alviso County Marina, which the County opened in 1966. Each time, the marina was dredged to a depth of approximately -10 feet mean sea level to maintain draft depths for boats. After each dredging event, rapid sedimentation occurred (about 1 to 2 feet/year) (Ruth & Going, 1980). Presumably, the cost of maintaining the marina became too high, and dredging was discontinued after 1980. The marina was located in a small embayment off the main channel of Alviso Slough, where quiet conditions may have facilitated higher rates of sedimentation than would naturally occur along the more dynamic main channel.

While dredging of the Alviso County Marina did not significantly affect the morphology of Alviso Slough, the high rates of sedimentation measured after dredging indicate that sediment was readily available for deposition. The high rates of sedimentation recorded at this site are consistent with other sedimentation trends in the far South Bay and with regional erosion and deposition trends observed over the last century. Sedimentation data reviewed from Palo Alto Yacht Harbor and Warm Springs Marsh, located to the north and east, respectively, of the Alviso area, indicate similar sedimentation rates (1–2 feet/year). Other restoration sites farther north (e.g., Cooley Landing and Stevens Creek marsh) indicate net sedimentation, but at a slower rates. General changes in bay bathymetry over the last century also indicate that the far South Bay has consistently remained a depositional environment, while other parts of the South Bay have experienced periods of erosion and deposition. In addition, the amount of deposition observed in the far South Bay exceeds the potential contribution from local tributaries. These regional observations support the notion that the net transport of sediment is from north to south in San Francisco Bay, and that the sediment is deposited in the far South Bay.

Sedimentation along the slough and in the former Alviso County Marina has resulted in a gradual expansion of marsh vegetation. Species composition has also changed over this time period, with conversion from salt to brackish plants and newly formed freshwater marsh habitat in areas upstream of the basin. These changes in vegetation suggest that the gradual reduction in channel cross-sectional area and tidal prism along the landward reach of Alviso Slough has increased the influence of freshwater discharges from the Lower Guadalupe River in structuring marsh plant communities in this area (H.T. Harvey & Associates 2005).

A sedimentation report for the Alviso Slough Restoration Project is included in Appendix C.

2.2.6 Present Morphology of Alviso Slough

The present morphology of Alviso Slough indicates that it continues to adjust to the historical reduction in the volume of the tidal prism. As with most other tidal sloughs within the far South Bay, Alviso Slough downstream of Montague Bridge is filling in with readily available estuarine sediment. Sediment is accumulating along the channel banks and fringing marsh plain, narrowing the channel and steepening the channel bank slopes. Additional cross-sections confirm that the process of "thalweg deepening" has occurred farther upstream of the Alviso Marina Transect between 1996 and 2004 (Appendix D).

2.2.7 Current Flood Protection in the Alviso Area

Between 2002 and 2004, the District constructed the channel improvements for the current Lower Guadalupe River Flood Protection Project (LGRP) and the Downtown Guadalupe River Flood Protection Projects, both of which provide 1 percent flood protection from I-280 in San Jose to the Alviso County Marina. These projects include a combination of floodwalls, levees, and channel improvements.

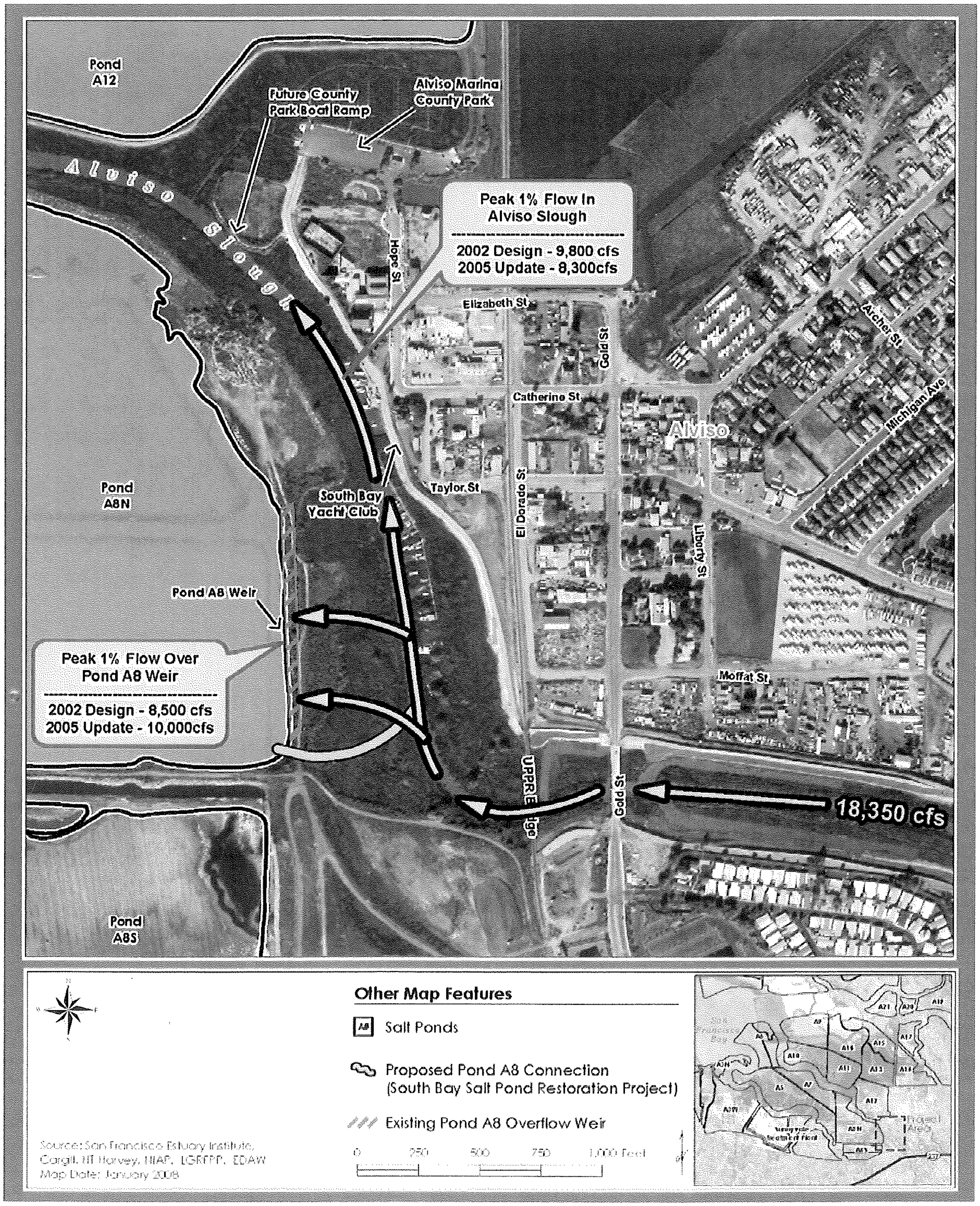
The LGRP was designed in 2002 to effect a flow split in the channel downstream of the UPRR Bridge. Flood flows in excess of the current channel capacity would flow over a diversion weir into Pond A8. Overflows to Pond A8 were designed to occur when Guadalupe River flows exceed a 9- or 10-year event (peak flow of 5,000 – 6,000 cfs).

Figure 2-1 provides a graphic representation of the designed flood management in the Alviso area. As stated earlier, the anticipated 1 percent (100-year) peak flow in the Guadalupe River at Alviso is 18,350 cfs. At this peak, the LGRP was designed to send a flow of approximately 8,500 cfs over the weir into Pond A8, while the remaining flow of about 9,800 cfs would be conveyed down Alviso Slough to the Bay. In such a large flood event, Pond A8 would overflow the interior levees within the salt pond system and flood Ponds A7, A5, and A6. To drain the pond system after such an event, District staff would install temporary pumps into Ponds A5 through A8. This effort would take approximately 6 weeks.

The LGRP project's long-term operations and maintenance plan includes performing a detailed cross-section survey of the Alviso Slough channel from the Bay upstream to Gold Street every 5 years. A cross-section survey was conducted in fall 2004 after the flood protection work was completed. The updated survey information was incorporated into the hydraulic model for the LGRP system. The modeling results indicate that the open channel width between the Gold Street Bridge and the Bay has narrowed further since the surveys conducted in the late 1990s for the LGRP design. As a result, the peak conveyance capacity of the slough channel downstream of the Alviso County Marina during a one-percent event has been reduced from 9,800 cfs to 8,500 cfs. The updated peak overflow to Pond A8 via the weir increases from 8,500 cfs to approximately 10,000 cfs (see Figure 2-1). The hydraulic modeling confirms that, despite the shift in the flow split due to changing downstream channel conditions, three feet of freeboard is maintained at the levees along the east bank of Alviso Slough, and 4 feet of freeboard is maintained at the UPRR and Gold Street bridge crossings. Table 2-1 summarizes the 2002 design and the 2005 updated flow splits for Alviso Slough.

Table 2-1 Hydraulically-Modeled 1 Percent Peak Flow Split between Pond A8 Weir Overflows and Alviso Slough Flows Downstream of Alviso County Marina

Condition	Peak 1% Flow at Gold Street Bridge (cfs)	Peak 1% Flow to Pond A8W (cfs)	Peak 1% Flow in Alviso Slough d/s of Alviso County Marina (cfs)
2002 Design	18,350	8,500	9,800
2005 Condition	18,350	10,000	8,300



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NAIP, LGRFPP, EDAW
Map Date: January 2008

Figure 2-1. One-Percent Flood Flow Split Between Alviso Slough and Pond A8

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The 2005 hydraulic modeling update of peak flow over the Pond A8 weir in a 1 percent event affects the ability of the Pond A5-A8 complex to store all the overflows during a one-percent event. Modeling the inflow-storage relationship for these four ponds for the 2002 design flow split indicated that most of the overflows during a 1 percent event would be contained within the ponds, with a slight chance of some flows spilling into Guadalupe Slough from low spots along Pond A5. With the updated (2005) 1 percent event flow split in Alviso Slough, a higher volume of Guadalupe River flows may overflow to the Pond A5-A8 complex, increasing the potential for higher spills from A5 to Guadalupe Slough. This may result in erosion or damage to the Pond A5 levees along Guadalupe Slough. In the event of such an occurrence, the District would coordinate levee repair and/or armoring with U.S. Fish & Wildlife Service, the owner of this pond complex.

2.2.8 Current Channel Maintenance in the Alviso Area

The Lower Guadalupe River Flood Protection Project's operations and maintenance plan includes vegetation mowing and sediment removal to maintain channel conveyance capacity. The activities conducted in the O&M plan have been permitted and are monitored by various regulatory agencies. As shown in Figure 1-11, side channels can be excavated upstream of the Gold Street Bridge, and deposited sediment can be removed from these channels as necessary. The maintenance permits require a minimum 20-foot wide fringe of marsh along the low flow channel so as to protect the habitat this marsh growth provides there.

The permitted maintenance activities also include vegetation mowing and/or herbicide application in the areas as shown in Figure 2-2. The intent of vegetation mowing downstream of the UPRR Bridge is to "channel" high flows toward the Pond A8 overflow weir, located on the west bank of the Alviso Slough channel as it curves to the north (Fig. 2-1). The mowed vegetation usually re-grows within a period of 6 months; thus, annual mowing and spraying is performed in the fall just in advance of the rainy season. As with the excavation of side channels upstream of Gold Street, mowing or spraying of marsh vegetation must exclude a minimum of 20-foot wide marsh fringe along the low flow channel.

The District may, in the future, obtain additional permits for maintenance work in the reaches of Alviso Slough to ensure that the flow split between the Pond A8 overflow weir and the downstream Alviso Slough channel provides one-percent riverine flood conveyance. Such maintenance would probably be in the form of vegetation mowing/spraying and/or the excavation of side channels parallel to but not connected to the existing low flow channel. It is expected that the regulatory agencies would also require protection of a minimum 20-foot wide fringe of marsh along the low flow channel for any future permits.

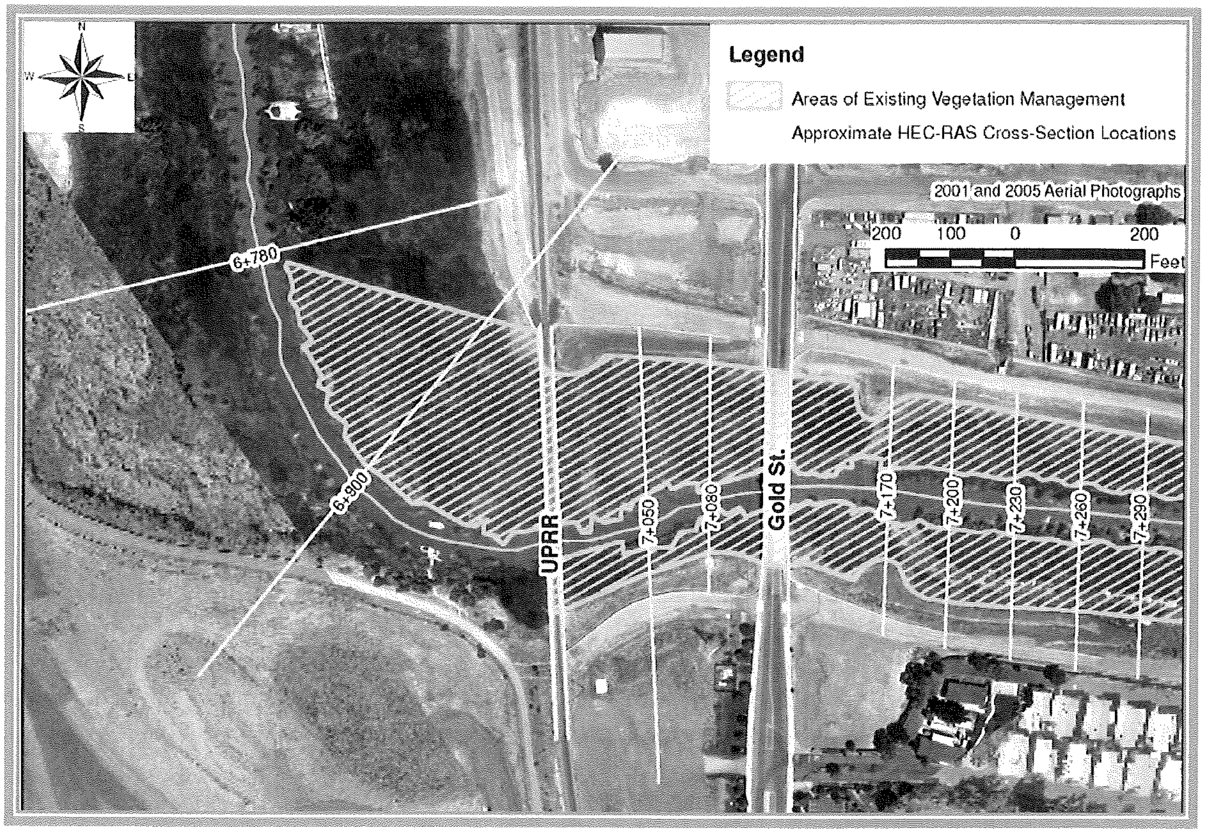
N
W
E
S
Legend
Areas of Existing Vegetation Management
Approximate HEC-RAS Cross-Section Locations
2001 and 2005 Aerial Photographs
200 100 0 200
Feet
6+780
6+900
UPRR
7+050
7+080
Gold St.
7+170
7+200
7+230
7+260
7+290

Figure 2-2. Areas of Permitted Ongoing Vegetation Management for the Lower Guadalupe River Flood Protection Project

2.3 Water and Sediment Quality

2.3.1 Water Quality

Water quality concerns related to healthy habitat for fish include dissolved oxygen, turbidity, salinity, and temperature.

Dissolved Oxygen

For the regional area and Alviso Slough, concentrations of at least 5 milligrams per liter (mg/L) oxygen are desired to support fish. Factors typically leading to oxygen depletion in estuarine environments are increased phytoplankton growth, low flow rates and low mixing. From a 1996 to 2003 dataset, dissolved oxygen in the Lower South Bay ranged from 4.30 to 10.00 mg/L, with 96 percent of measurements equal to or greater than the water quality objective of 5 mg/L. The measurements in the southern sloughs ranged from 0.43 to 12.18 mg/L with 78 percent of measurements equal to or greater than 5 mg/L. USGS measured dissolved oxygen in Alviso Ponds A8 and A12 during monthly sampling from 2002 to 2006. The majority of measurements ranged from 4 to 10 mg/L. While some measurements were below concentrations considered healthy for aquatic life, the proposed changes to Pond A8 and actions under the adaptive management plan for the SBSP Restoration Project are expected to improve dissolved oxygen in the salt ponds and mitigate potential adverse affects on Alviso Slough.

Salinity

Salinity in the South Bay is governed by salinity in the Central Bay, exchange between the South and Central Bays, freshwater tributary inflows to the South Bay, and evaporation. In general, the South Bay is vertically well mixed (i.e., there is little tidally-averaged vertical salinity variation) with near oceanic salinities due to low summer and fall freshwater inputs to the far South Bay. Seasonal variations in salinity are driven primarily by variability in freshwater inflows. In winter and early spring in wet years when fresh water from the San Francisco Bay Delta intrudes into the South Bay, salinity conditions are often dynamic, characterized by unsteady flows, variable salinity and periodic vertical stratification (Life Science 2003). As Delta and tributary inflows decrease in late spring, salinity increases to near oceanic salinities. The largest source of fresh water flows to the South Bay during summer months comes from the local municipal wastewater treatment plants.

Temperature

Temperature data collected in the lower South Bay and South Bay sloughs ranges from 8 to 25 degrees Celsius (deg. C). The median temperature is 19 deg. C. Water temperature is expected to vary seasonally with ambient air temperature and changes in tides and freshwater inflows. USGS collected temperature data from Alviso Ponds A8 and A12 during monthly sampling from 2002 to 2006. Temperatures in both ponds ranged from about 10 to 28 deg. C with the lowest temperatures in December and the highest in July (Takekawa et al., 2005). Typical temperature conditions in Pond A8 will change if the pond is opened to tidal action and the average water depth is increased as planned under the South Bay Salt Pond Restoration Project.

2.3.2 Sediment Quality

There are known historic industrial Polychlorinated Biphenyl (PCB) spill sites in the Guadalupe River watershed, upstream of Alviso Slough. The Santa Clara Valley also has a history of agriculture that would explain the relatively high concentrations of legacy organochlorine pesticides. The presence of several legacy pollutants, including mercury, PCBs, and organochlorine pesticides, was analyzed in sediments. Collectively, these pollutants are referred to as Persistent Bioaccumulative[1] Toxicants (PBTs), as they accumulate in the food web, potentially affecting people and wildlife that eat fish and other protein sources from the bay. Detailed conceptual models for each of these pollutants have been developed by the San Francisco Bay Clean Estuary Partnership (CEP). The CEP conceptual models and impairment assessment reports summarize the current concentrations of PBTs in fish, the current spatial variation of the PBT concentrations in bay sediments, and the current inventory of the PBTs in the upper layer of bay sediments.

Sediment quality information obtained from review of published literature, supplemented with results from limited analytical testing of sediment samples collected from Alviso Slough in conjunction with an ongoing study by the United States Geological Survey, indicates that pollutant concentrations in sediments from the Project area likely would preclude beneficial re-use of this material as surface cover. None of the concentrations of PBTs observed were high enough to warrant disposal of the sediments as hazardous waste. However, essentially all of the PBT concentrations observed were high enough to justify recommending that dredged sediments not be placed as wetland surfaces. Some of the PBT concentrations (e.g., total mercury, chlordanes) were high enough to make the deeper sediments unsuitable for placement in wetland foundation. It is assumed that all dredged sediments must be disposed of in a local landfill or other upland disposal alternative. More information would be needed to support a decision to use sediments from the Project area as wetland foundation.

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[1] Bioaccumulative means that a pollutant is concentrated from the ambient amount present in sediments or water to higher concentrations in fish. Bioaccumulation refers to the process of increasing pollutant concentrations at each successive level in the food chain.

2.4 Biological Resources

2.4.1 Habitat

Along with physical changes to the slough over time, changes in plant composition have also occurred. In the 1970s, studies by H.T. Harvey & Associates (1984) highlighted large-scale changes in marsh plant communities throughout South San Francisco Bay. Marshes once dominated by salt marsh plants, such as pickleweed (*Salicornia spp.*) and cordgrass (*Spartina spp.*), were colonized by brackish marsh plants such as alkali bulrush (*Scirpus maritimus*). In the late 1980s, efforts were made to determine the extent of these changes over time by analyzing historical aerial photographs (CH2M HILL 1989). Data suggested that large-scale vegetation changes were occurring not only through shifts in marsh type (from salt to brackish marsh), but also due to the formation of new marsh habitat.

For the past 15 years, the City of San Jose and other agencies have monitored Alviso Slough through vegetation mapping to determine changes in marsh plant composition and to provide baseline data for future comparisons. San Jose's mapping program began in 1989 and has since continued on a nearly annual basis. Mapping has been vital in detecting vegetation shifts that may have been otherwise undetectable. For example, mapping showed that 90.5 acres of new marsh formed in Alviso Slough from 1989 to 2005, a 54% increase. In this same period, 31.5 acres of salt marsh were converted to brackish marsh. Additionally, newly formed freshwater marsh habitat was detected in Alviso Slough (beginning in the area of the Alviso Marina), which suggests that freshwater influences are playing an increasing role in structuring the marsh plant communities in the vicinity of the Alviso Marina (H.T. Harvey & Associates 2005). These freshwater influences include reductions in the amount of tidal influence reaching the Alviso Marina area as the slough narrowed, changes in the quantity and timing of freshwater inputs upstream, and the changes in the historical slough-creek connections (H.T. Harvey & Associates 2005).

In addition to the changes in marsh plant communities, changes in wildlife populations have occurred. Historically, the South Bay contained a mosaic of habitats that supported diverse communities of animals. Utilization of bay habitats by wildlife, particularly bird species, was high. Accurate historical bird counts are rare due to the lack of official survey data, but accounts from hunters and naturalists support the idea that waterbird abundance and diversity were high.

Hunters reportedly killed thousands of California clapper rails each week prior to 1900 (Thelander et al. 1994). However, habitat loss has been the major factor in the drastic decrease in population size of the California clapper rail (USFWS 1984; Albertson and Evens 2000). Salt-marsh-dependent species are no longer present in the upstream portions of Alviso Slough, as the habitat has shifted to freshwater and brackish marsh. Local fishermen also report a shift in the fish being caught in Alviso Slough to more freshwater species (Laine 2006).

Today, Alviso Slough contains a continuum of salt, brackish, and freshwater marshes. Freshwater marsh plants dominate the southern reaches of the slough, which then give way to brackish and salt marsh species closer to Coyote Creek and South San Francisco Bay. Brackish marsh associations occur throughout the slough, with the majority of brackish marsh plant species located mid-reach between the Union Pacific Railroad (UPRR) bridge and the confluence of the slough with Coyote Creek. Brackish marsh vegetation is dominated by alkali bulrush, but also consists of peppergrass (*Lepidium latifolium*), a non-native invasive species, and spearscale (*Atriplex triangularis*). Freshwater marsh associations are concentrated in the upstream portions of the slough around the town of Alviso, in the area of freshwater input from the Guadalupe River. Dominant freshwater species consist of California bulrush (*Scirpus californica*) and cattail (*Typha* spp.). The vegetation composition within these marshes is dynamic in nature, and annual shifts in species composition are observed. However, the overall trend in vegetation in the area of the Alviso Marina over the past two to three decades has been a shift to fresher marsh types.

2.4.2 Wildlife and Fish

Ponds A8 and A12, which are immediately adjacent to the Project area, provide a range of wildlife habitat values. Observations have shown that wildlife usage in Pond A8 takes a variety of forms. Notably, a large number of shorebirds use the pond to roost and forage. Forster's terns nest within Pond A8 on small dredge-spoil islands that have little or no vegetation, and black skimmers have nested on these spoil islands alongside Forster's terns in recent years (Santa Clara County Bird Data, unpublished). An increasing breeding population of California gulls in nearby Pond A6 threatens to encroach on these nesting terns and skimmers. There is an especially large concentration of nesting and roosting gulls in Alviso due primarily to the abundant food resources provided by South Bay landfills, and due secondarily (for a few species) to foraging opportunities provided by the high abundance of invertebrates within mid- and high-salinity ponds. Bonaparte's gull, whose abundance is highest in Pond A8, tends to forage on salt-pond-based prey.

The endangered California least tern uses the Alviso/Mountain View area as a post-breeding staging area rather than a nesting area (Santa Clara County Bird Data, unpublished). The staging area is occupied from late June through late August, prior to the species' southward migration. Here, adult and juvenile least terns roost on levees that surround the salt ponds as well as those that lie in between ponds (S. Rottenborn, pers. obs.). They also roost on boardwalks and forage both in the salt pond and over the open waters of the bay. Least terns have occasionally been recorded using Pond A8 for foraging and roosting, though they tend to concentrate in ponds farther west (Santa Clara County Bird Data, unpublished).

The U.S. Geological Survey (USGS) also noted high abundances of black-necked stilts and American avocets in Pond A8 (USGS unpublished preliminary data). In addition, the federal threatened western snowy plover breeds in Pond A8, at least in some years (Santa Clara County Bird Data, unpublished).

Pond A12, in comparison, has seen only limited use by wildlife due to the pond's greater depth and higher salinity. Black-necked stilts and American avocets occasionally breed in low numbers on the pond's levees, and large numbers of gulls, herons, and other birds roost on the levees between Pond A12 and adjacent ponds. The amount and variety of bird use in Ponds A8 and A12 were considered during the development of project alternatives.

Salt marsh harvest mouse has had a limited presence in Ponds A8 and A12, based on data from trapping surveys. Trapping data show three capture locations in the vicinity of Ponds A8 and A12: two at the eastern edge of Pond A12 in New Chicago Marsh and one on the western edge of Pond A12 (H. Shellhammer, unpublished data). Due to a lack of habitat within Alviso Slough near the marina, salt-marsh-dependent species are not expected to occur in the proposed Project area.

Surveys of South Bay tidal sloughs in June and September 2004 (USGS unpublished preliminary data related to the SBSP Restoration Project) detected a total of 10 fish species. Northern anchovies and topsmelt were by far the most abundant species caught; American shad, bat ray, leopard shark, striped bass, staghorn sculpin, shiner surfperch, green sturgeon, and yellowfin goby were also noted. Grass shrimp and Spanish mackerel have also been observed (Laine 2006). Anadromous salmonids such as steelhead, a federal threatened species, and Chinook salmon, a federal species of concern and California species of special concern, migrate through Alviso Slough.

2.5 Land Use

Located at the northernmost edge of San Jose, the community of Alviso is characterized by its small town atmosphere, rich history, bayside location, marinas, wide-open spaces, agricultural activities, and a mix of residential, commercial, and industrial uses. Alviso has its own distinct sense of place, despite its close proximity to the suburban communities and high-technology industrial parks of Silicon Valley (Alviso 2006).

Alviso was incorporated in 1852 and consolidated with the city of San Jose in 1968. The Alviso planning area includes all properties within San Jose north of Highway 237, between Coyote Creek and the Guadalupe River. The entire planning area is roughly 10,730 acres.

The Alviso village area includes the historic western grid, the neighborhood grid, and the lands on both sides of North First Street from Liberty Street to the southern boundary of the George Mayne School. Existing land uses in the village include single-family residences, some duplexes, triplexes, and small apartment buildings, small grocery stores, restaurants, warehouses, and trucking operations. The village area also contains San Jose's only yacht club and associated harbor.

The California State Lands Commission generally owns the reach of Alviso Slough that passes through the Project area. Portions of the Alviso Pond complex are part of the Don Edwards San Francisco Bay National Wildlife Refuge, which has been under USFWS management since its 2002 purchase from Cargill. The USFWS manages its lands pursuant to the National Wildlife Refuge System Administration Act of 1966 and the Refuge Recreation Act of 1962, as well as other laws, executive orders, regulations, and policies.

2.6 Geology

Alviso Slough and the surrounding mudflats, marshlands, sloughs and salt evaporation ponds are located in South San Francisco Bay which lies within the Coast Ranges geomorphic province. The major geographic features in the area include the Diablo Range, Santa Cruz Mountains, San Francisco Peninsula, and San Francisco Bay. In the Coast Ranges, older, consolidated rocks are exposed in the mountains but are buried beneath younger, unconsolidated alluvial fan and fluvial sediments in the valleys and lowlands. San Francisco Bay occupies a late Pliocene structural depression that extends south of the Project area and underlies Santa Clara Valley.

The region is tectonically and seismically active. Structural geology in the region is dominated by major active strike-slip faults associated with the San Andreas Fault System. The geologic structure of the San Francisco Bay and Santa Clara Valley is characterized as a structural trough bounded by two uplift blocks forming the Diablo Range and East Bay Hills on the east, and the Santa Cruz Mountains on the west.

Geologic hazards related to landslides, seismically induced landslides, and surface fault ruptures are not likely in the Project Area. Expansive, compressible, and corrosive soils, although potentially present in the Project Area, are not hazards to an activity such as dredging of the slough, as no permanent structures are planned. Soil erosion, particularly during sediment dredging, is a potential geologic hazard.

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Chapter 3
Regulatory Setting

3.1 CEQA/NEPA

For discretionary projects such as the Alviso Slough Restoration Project, the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) require the preparation of an environmental document, subject to public review, that evaluates a reasonable range of project alternatives, in addition to a mandatory "no project" scenario. Under CEQA, the reasonable range includes those alternatives that (1) meet all or most of the project objectives, (2) are ostensibly feasible, and (3) would avoid or lessen significant environmental effects of the project. There is no required minimum or maximum number of alternatives, but CEQA and NEPA documents typically analyze three to five alternatives, including the No Project Alternative.

Under CEQA, an EIR need not consider every conceivable alternative to the project. Rather, the EIR must consider a reasonable range of potentially feasible alternatives that will foster informed decision-making and public participation. An EIR is not required to consider alternatives that would be infeasible. The lead agency (in this case, the District) is responsible for selecting a range of project alternatives for examination and must publicly disclose its reasoning for selecting those alternatives (CEQA Guidelines Section 15126.6). The CEQA and NEPA documents must also identify alternatives that were considered but rejected, and explain why these alternatives were not advanced for further evaluation.

Finally, CEQA stresses the importance of meaningful public participation in the identification of possible alternatives and impacts. In addition to special topic meetings with the local community, the District conducted public scoping meetings in August and September 2007 to solicit input on project alternatives from all interested parties, such as Bay Area residents, environmental and recreational organizations, and regulatory agencies. The District also held a public hearing for The Draft EIR and the Draft Engineer's Report in July 2008.

The EIR for the Alviso Slough Restoration Project evaluates the probable environmental impacts of each of the six alternatives. This Engineer's Report evaluates each alternative and identifies a Staff-Recommended Alternative. By District policy, the Engineer's Report must identify one alternative and prepare a detailed examination of its engineering properties. After a public review process, the District's Board of Directors may elect to pursue the Staff-Recommended Alternative, select one of the other project alternatives, or take no further action on the project.

As part of the CEQA scoping process, a public scoping meeting was held on August 30, 2007 in Alviso to solicit comments on environmental issues to be addressed in the EIR. Public comments were received by mail. A public hearing for the Draft EIR was held on July 16, 2008 to receive oral comments from the public.

3.2 Regulatory Approvals

To a large degree, the project definition, purpose, and need determine the specific types of approvals requested from the resource agencies. The range of discretionary approvals that would be necessary to implement the Project would depend, for example, on whether the selected alternative would remove vegetation with little sediment, or would dredge the slough. Essential to all of these permitting considerations is a clear purpose and need for the project. The regulatory agencies all indicated at an early stage of project development that the alternatives should have a well-defined footprint and specific purpose (ideally, water-based recreation).

3.2.1 Federal Regulations

Federal Endangered Species Act
The Federal Endangered Species Act (ESA) protects special-status fish and wildlife species and is administered by the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). In addition to the federal ESA, the NMFS reviews projects under the Magnuson-Stevens Fishery Conservation and Management Ac, whereas the Fish and Wildlife Coordination Act is under jurisdiction of the USFWS, among others. In the San Francisco Bay Area, projects that take place in the spawning habitat of salmon or other federally-listed fish and wildlife would require review. The USFWS evaluates impacts on fish and wildlife of all federally-permitted projects, including projects subject to the requirements of Clean Water Act Section 404 and Section 10 (the Rivers and Harbors Act).

Sustainable Fisheries Act (PL 94-265)
The Sustainable Fisheries Act amends the Magnuson-Stevens Act to protect areas deemed as Essential Fish Habitat for protected fish species. Consultation with the NMFS is required on activities that might adversely affect Essential Fish Habitat.

Clean Water Act, Section 401
Under Clean Water Act Section 401, applicants for a federal permit or license for any activity that could result in a discharge to a water body must obtain state water quality certification that the proposed activity will comply with applicable standards. Impacts on waters of the state are authorized through waste discharge requirements, which typically require mitigation assuring "no net loss" of wetland functions and values. The San Francisco Bay Regional Water Quality Control Board (RWQCB) administers state water quality certification in the Bay Area and is responsible for prescribing measures to avoid, minimize, and mitigate adverse impacts on water quality and ecosystems.

As part of the permit application and process, analysis of sediment and water quality effects may be required prior to or during construction. Mercury contamination in the proposed Project area will increase the complexity of the waste discharge requirements. Data indicate low-level mercury contamination of sediments in the slough—comparable to the levels in the far South Bay; the levels quantified to date would require land disposal of any removed sediments.

Clean Water Act, Section 404
Under Section 404 of the Clean Water Act, project applicants must obtain a permit from the USACE before undertaking any activity that involves the discharge of dredged or fill material

into "waters of the United States," including wetlands. Waters of the United States include navigable waters of the United States, interstate waters, all other waters where the use or degradation or destruction of the waters could affect interstate or foreign commerce, tributaries to any of these waters, and wetlands that meet any of these criteria or that are adjacent to any of these waters or their tributaries. Many surface waters and wetlands in California, including Alviso Slough, meet the criteria for waters of the United States.

Section 404 requires the USACE, as the federal lead agency, to consider impacts on species that are subject to the Federal Endangered Species Act. USACE must also consult with USFWS and/or NMFS, as appropriate or necessary, under the respective jurisdictions. It thereby incorporates USFWS and NMFS findings on impacts regarding federally listed fish species in its permit conditions. The U.S. Environmental Protection Agency (EPA) has jurisdictional authority over the Clean Water Act and can enter the permit review process at any time. The EPA can also veto a Section 404 permit issued by the USACE.

National Historic Preservation Act: Section 106 Review
Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects of proposed federal undertakings on historic properties. The act requires federal agencies (and their designees, permittees, licensees, or grantees) to initiate consultation with the State Historic Preservation Officer as part of the Section 106 review process.

3.2.2 State Regulations

Porter-Cologne Water Quality Control Act
The Porter-Cologne Water Quality Control Act requires the State Water Resources Control Board, acting through the nine regional boards, to certify that a USACE permit action meets state water quality objectives. Wetlands and drainages that the USACE considers waters of the United States are often classified as waters of the state as well; however, waters of the state can also include waters the USACE deems to be non-jurisdictional under Section 404 of the Clean Water Act.

Fish and Game Code Section 1602, Lake and Streambed Alteration Agreements
All diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by the CDFG under Section 1602 of the California Fish and Game Code. Under Section 1602, it is unlawful for any person, governmental agency, or public utility to do the following without first notifying the CDFG: substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake. A stream is defined as a body of water that flows at least periodically or intermittently through a bed or channel that has banks and supports fish or other aquatic life. This definition includes watercourses with a surface or subsurface flow that supports or has supported riparian vegetation. The CDFG's jurisdiction over altered or artificial waterways is based on the value of those waterways to fish and wildlife. A CDFG streambed alteration agreement must be obtained for any project that would result in an impact on a river, stream, or lake.

California Endangered Species Act
The CDFG, as the trustee agency for fish and wildlife resources, provides the requisite biological expertise to review and comment on environmental documents and impacts arising from project activities and makes recommendations regarding those resources held in trust for the people of California. Section 2080 of the Fish and Game Code prohibits the "take" of any species that the CDFG determines to be an endangered species or a threatened species. Under the California Endangered Species Act, "take" is defined as an activity that would directly or indirectly kill an individual of a listed species. The act allows for take that is incidental to otherwise lawful development projects.

McAteer-Petris Act
The McAteer-Petris Act empowers the San Francisco Bay Conservation and Development Commission (BCDC) to issue or deny permits for any project that involves placing fill, extracting materials, or making any substantial change in use of any water, land, or structure within San Francisco Bay.

The BCDC's main goals are to prevent unnecessary filling of the bay, promote appropriate water-oriented shoreline development, protect Suisun Marsh, and provide maximum public access to the bay. Any person proposing to fill, extract materials, or change the use of water, land, or structures in or around San Francisco Bay must first obtain a permit from BCDC.

In accordance with guidelines set forth by the USACE, vegetation and root mass removal or dredging for recreational enhancement or navigation is a water-dependent activity, and one that is consistent with BCDC policies for encouraged uses of San Francisco Bay.

3.2.3 Local Regulations

City of San Jose, Public Works Permits
The City of San Jose Department of Public Works requires the preparation of a traffic control plan to allow contractors to work within the public right of way efficiently and effectively while maintaining a safe, uniform, flow of traffic.

Public Works also requires the any grading or excavating activities to obtain a "Notice of Exemption" or "Grading Permit". This permit is intended to establish uniform standards to safeguard life, limb, property, water quality, and natural resources, and to promote the public welfare by regulating grading. Other requirements for this permit include a "Haul Route Permit" when a project moves more than 10,000 cubic yards of earth.

Chapter 4
Development and Evaluation of Alternatives

4.1 Conceptual Alternatives

4.1.1. Identification of Conceptual Alternatives

The District considered a wide variety of project actions at the broad planning level. The resulting conceptual alternatives included:

- Vegetation and Root Mass Removal
- Dredging
- Ferry Terminal Alternative
- Environmental Enhancements Only Alternative
- Land-Based Enhancements Only Alternative
- Community-Based Financing Alternative
- Restoration of the Historic Guadalupe River Channel

This list was then screened based on the following factors and input:

- Project objectives
- Engineering feasibility
- Sustainability
- Environmental factors, including permitting requirements
- Community feedback

Some potential alternatives were rejected because they did not meet the above criteria. The alternatives that were eliminated from further study and the reasons for their elimination are discussed below.

Ferry Terminal Alternative
This alternative would involve developing a ferry terminal in Alviso for commuters and/or cargo handling. A ferry terminal would require extensive deep dredging and regular maintenance of the slough and basin for ferryboat operations, which also would encourage recreation and tourism in the area. Such an action could not be pursued by the District (the District does not have government mandate for these services), but would have to be implemented by the San Francisco Bay Area Water Transit Authority which has regional jurisdiction in this area, perhaps in partnership with the City of San Jose which has land use jurisdiction, and the U.S. Army Corps of Engineers. The Water Transit Authority has not identified Alviso as a future location for a South Bay ferry terminal, although nearby Moffett Field is under consideration. For these reasons, this alternative was rejected from further study.

Environmental Enhancements Only Alternative

This alternative would focus exclusively on removing any identified hazardous sediments from the slough. To implement this alternative, an extensive study of sediment quality would be required, and the location and intensity of contamination, if any, would be identified. Any subsequent sediment removal would focus on areas of contamination and/or hazard. As such, this alternative would not meet several of the Project objectives and was, therefore, rejected from further study.

Land-Based Enhancements Only Alternative

This alternative would focus solely on land-based recreational enhancements in Alviso, such as providing additional public access, trails, or other facilities near the slough. Initial research revealed that city and regional recreational planning efforts are already underway with an objective to improve many aspects of public access and trail use in the Project Area. Additionally, while focusing on land-based recreational enhancements would avoid many anticipated impacts of vegetation removal or dredging in the slough, it does not meet the primary Project objective of restoring the slough's channel width to pre-1983 conditions; therefore, this alternative was rejected from further study.

Community-Based Financing Alternative

For this alternative, channel modification would be undertaken by funding through a Community Benefits District (CBD; sometimes referred to as an assessment district). A CBD is an instrument that provides funds for the regular maintenance and upkeep of public improvements, and is funded by an assessment fee assigned to all properties that receive the benefit of the improvements. In a CBD:

- Fees are assessed on property owners, who may, in some cases, be able to partially pass through some costs to property tenants and area customers;
- A board is formed to oversee the CBD's operations, collect assessments, and disburse funds for supplemental services, activities, and improvements, as agreed to by the community members;
- Funds collected from the CBD are used solely for the maintenance and replacement of items within that CBD, such as streetscapes and other physical improvements in the community; and
- In Alviso, a CBD could be used to fund some or all of the vegetation removal and continuing maintenance in the slough area.

When undertaking the development of a CBD, several important issues must be considered. A CBD can only be established by a majority vote of the property owners, and the adoption of an ordinance by a city council. However, a CBD or Financing District formation is usually a function of the City of San Jose or County of Santa Clara which normally would have expertise in this area. For these reasons, this alternative was rejected from further study.

Restoration of the Historic Guadalupe River Channel

This alternative would involve the restoration of the historical Guadalupe River channel within the Project Area. The Guadalupe River formerly flowed northwest, through what is now Pond A8, and entered San Francisco Bay through Guadalupe Slough. As described in Chapter 1, the river was first connected with Alviso Slough sometime in the 1850s, and for almost 90 years, flowed to the Bay both via Guadalupe Slough and Alviso Slough. With the creation of the salt evaporation ponds in the 1940s, the Guadalupe River-Guadalupe Slough connection was severed, and the river now flows to the Bay only via its man-made 1850's connection to Alviso Slough. Both sides of Alviso Slough were leveed to create the salt ponds in the 1940s.

Recreating the former Guadalupe River channel would require major planning and re-engineering of the current salt pond levee system. For such an undertaking to be sustainable, an extensive restoration planning effort would be necessary—not only for the immediate Project Area, but for a much greater area. Furthermore, a connection between Alviso Slough and Pond A8 is currently planned as part of the South Bay Salt Pond (SBSP) Restoration Project, and this connection must be in a stable, accessible location so that the SBSP Project sponsors can monitor its success as well as any ecological changes that might result. Over time, the SBSP Project could promote a permanent connection between Pond A8 and Alviso Slough. For these reasons, this alternative was rejected from further study.

4.2. Development and Evaluation of Feasible Alternatives

Six feasible alternatives were developed for detailed evaluation, including the required No Project Alternative. Each of the five action alternatives includes the removal of vegetation and root mass from both banks of Alviso Slough between Gold Street Bridge and the Alviso County Marina. Three action alternatives also include various depths of dredging of Alviso Slough to address the project objectives developed collaboratively with members of the Alviso community.

The feasible alternatives are:

- Alternative 1: Vegetation and Root Mass Removal (2.6 acres) to a 4-foot depth
- Alternative 2: Vegetation and Root Mass Removal (7.0 acres) to a 4-foot depth
- Alternative 3: Vegetation and Root Mass Removal and Dredging (3.7 acres) to an 8-foot depth
- Alternative 4: Vegetation and Root Mass Removal and Dredging (6.2 acres) to a 16-foot depth
- Alternative 5: Vegetation and Root Mass Removal (15.3 acres) to a 4-foot depth and Dredging (additional 9.7 acres) to a 10-foot depth
- Alternative 6: No Project

The analysis of each alternative is presented below. Two scenarios are evaluated for each alternative: one is based on a completed/ successful SBSP Phase 1 Action at Pond A8 and the second assumes that this Phase 1 Action is not implemented, or is halted. The assessment of each alternative includes how it would meet project objectives, project sustainability, identification of key environmental and regulatory issues, impacts to hydraulics of the channel, and estimated capital and long-term operations and maintenance costs. A detailed evaluation of environmental impacts of each alternative is documented in the Environmental Impact Report prepared in tandem with this Engineer's Report.

4.2.1 Alternative 1: Vegetation and Root Mass Removal (2.6 acres)

Description

Alternative 1 would remove approximately 2.6 acres of vegetation and root mass in the Project Area to a depth of 4 feet. Vegetation and root mass would be removed using a multi-purpose aquatic maintenance vessel, such as the Aquamog system owned and operated by Aquatic Environments, Inc. Figure 4-1 shows Aquamog operations during a 2004 demonstration in the Guadalupe River. The Aquamog performs the same tasks on water as backhoes and excavators perform on land. It includes clamshells for dredging, slotted clam buckets for vegetation removal, rototilling for vegetation root mass removal, and rotary mowers for shoreline vegetation control.

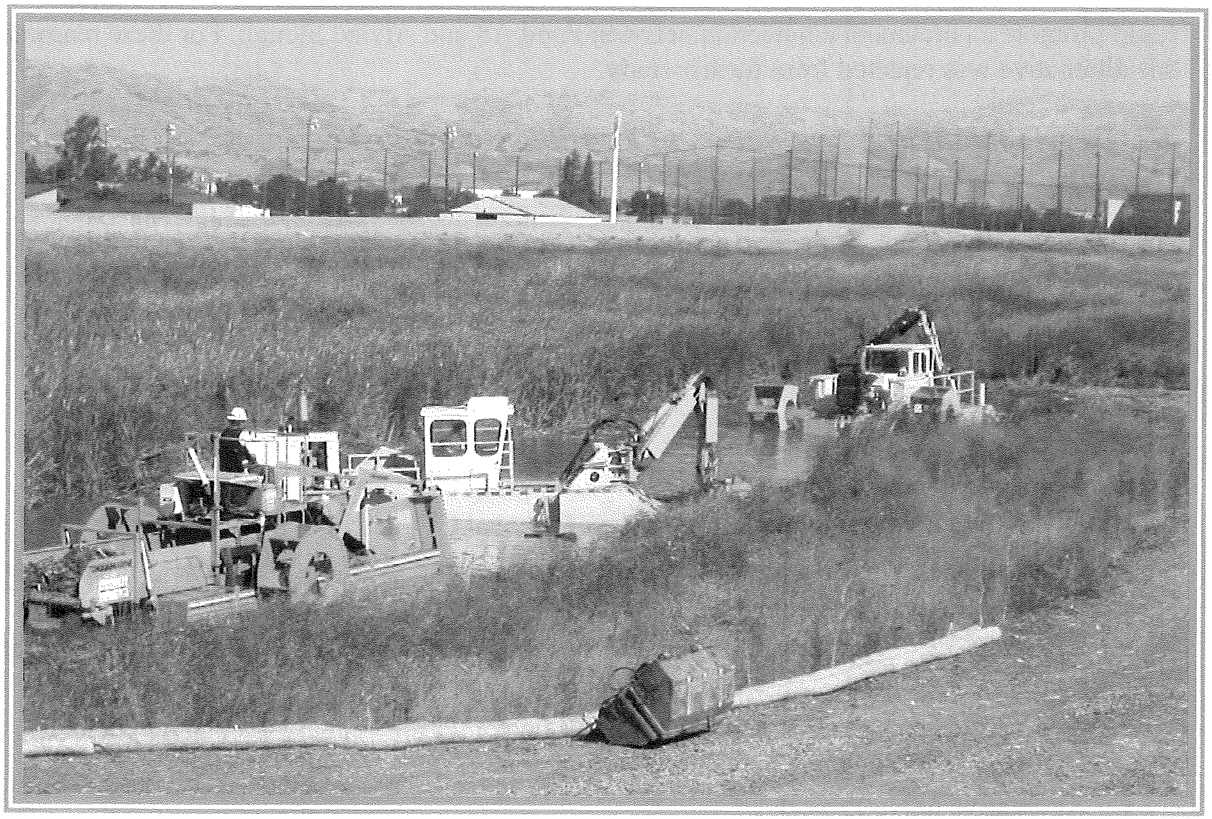


Photo courtesy Aquatic Environments, Inc.

Figure 4-1. Aquamog Demonstration in Guadalupe River, 2004

The rotovation method is often used for long-term aquatic vegetation control. The blades on a rotovator can till and/or dislodge plant roots up to a depth of 16 feet at a rate of approximately 0.5 acre per day and remove 100% of root material. This method would cut the vegetation down to the water surface, then tills the submerged vegetation and its root mass by the rotovator. An aquatic weed harvester would then be used to collect vegetation debris. A turbidity screen would be installed around the vegetation removal area to prevent impacts to water quality as a result of any floating debris from the removal process.

The footprint for the proposed 2.6 acres of vegetation and root mass removal is shown in Figure 4-2. Removal of vegetation and root mass would extend approximately 1,400 feet along the east side of the channel. The width of the project work would vary between 30 and 100 feet. The current average slough channel width between Gold Street and the County Marina is approximately 50 feet. This alternative would result in an average open channel width of approximately 80 feet.

The project work would clear the affected area for a period of time. Actual deepening of the slough bottom after removal of the root material with this method is expected to be minimal, and would vary based on location, scour, extent of root mass, etc. While some of the newly loosened sediment (especially in the area opposite of the A8 notch) could be transported downstream, a good portion would likely re-deposit in place or on downstream mudflats. New vegetation would re-colonize the project footprint within a few years. Alternative 1 actions would require re-deployment of the rotovator to remove vegetation and root mass approximately every 3 years until the SBSP Phase 1 Action at Pond A8 were fully implemented (i.e., until the entire 40-foot notch would be open year-round, or full tidal action is restored). If the Phase 1 Action at Pond A8 is not implemented or is halted, this alternative would require regular maintenance indefinitely.

Using a 2005 aerial photo of the slough and applying visual simulation techniques, Figure 4-3 provides "before" and "after" views of the slough for Alternative 1. The 2005 photos were taken during a low tide; thus, the visual simulation shows the "after" view at low tide as well. The removal of vegetation and root mass to a depth of 4 feet would result in exposed mudflats during low tide, which would be covered with water during high tide.

The footprint of Alternative 1 takes advantage of the proposed SBSP Phase 1 Action at Pond A8 semi-tidal restoration activities, which could significantly reduce impacts and ongoing maintenance requirements attributed to the Alviso Slough Restoration Project. The exact location and extent of scour that is anticipated as a result of the SBSP Phase 1 Action at Pond A8 is not known. In the Alviso Slough Restoration Project area, it is assumed that approximately 2 to 5 acres would scour within the first 10 years of the SBSP Phase 1 Action, depending on the size, management, and success of the notch operations. If existing wetland habitat were to be removed by scour from the SBSP Phase 1 Action at Pond A8 first, the Alviso Slough project would only be responsible for mitigation of the remaining area of direct wetland removal.

Benefits of coordination with the SBSP Restoration Project include directing scour from the Phase 1 Action into desired areas, thereby enhancing navigation opportunities (recreational boating) in the vicinity of existing docks; minimizing uncontrolled, loosened, vegetation/sediment masses in the Slough by removing vegetation near the areas expected to scour; and minimizing impacts to existing wetlands and related mitigation costs.

Alternative 1 would include the removal of debris from the Project area, including abandoned vessels, unused docks, and sunken vessels, if not already resolved by the Bay Conservation and Development Commission (BCDC), California State Lands Commission (CLSC) the District, and the South Bay Yacht Club (SBYC). All procedures as required by state law would be followed to identify the owners of vessels in the Project area, and those owners would be responsible for moving vessels from the Project area before construction would begin. Any vessels determined to be abandoned would be salvaged for sale, or would be dismantled and discarded. All procedures would follow the California Department of Boating and Waterways guidelines for abandoned boat removal.

Removal of vegetation and root mass would be performed around and under the existing active docks and piers on the east side of Alviso Slough within the Project area. If piers or docks are damaged or displaced in the process, they would be re-installed after completion of work.

Figure 4-4 presents a cross-section view of Alviso Slough (looking downstream) in the vicinity of the South Bay Yacht Club (SBYC) and marks the conceptual extent of vegetation and root mass removal on the east side of the slough.

Meets Project Objectives

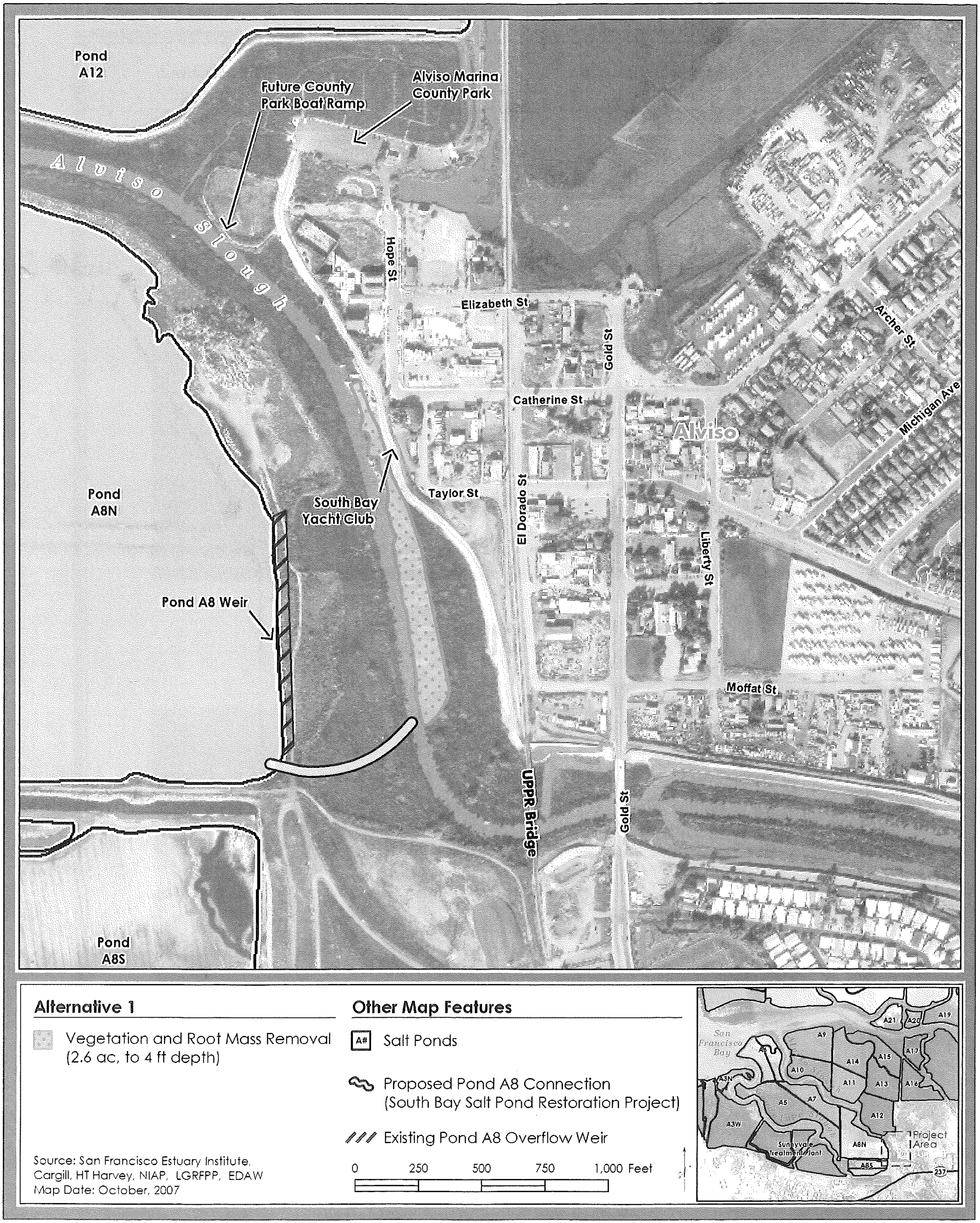
Alternative 1 represents the minimum footprint of impacts to wetland habitats that would partially meet the project objectives. While this alternative would not restore the slough to pre-1983 conditions, it would clear the area around existing boat docks, allowing for improvements for additional recreation and tourism in the area. However, minimal enhancement to the depth of the slough would be expected. Additional scour would likely occur in the slough after implementation of subsequent phases of the SBSP Restoration Project over the next decade or more, possibly restoring the slough to pre-1983 conditions.

Sustainability

If the SBSP Phase 1 Action at Pond A8 is successful over a 10-year period, it would reduce or eliminate the need to repeat vegetation and root mass removal in the Alviso Project area over the long-term. If the Pond A8 Notch operations are halted, more regular maintenance would be required indefinitely as part of the Alviso Slough Restoration Project. The cleared section would rapidly be re-colonized with marsh vegetation and improvements to navigation would be short-lived without repeated maintenance of the project area.

Environmental Impacts

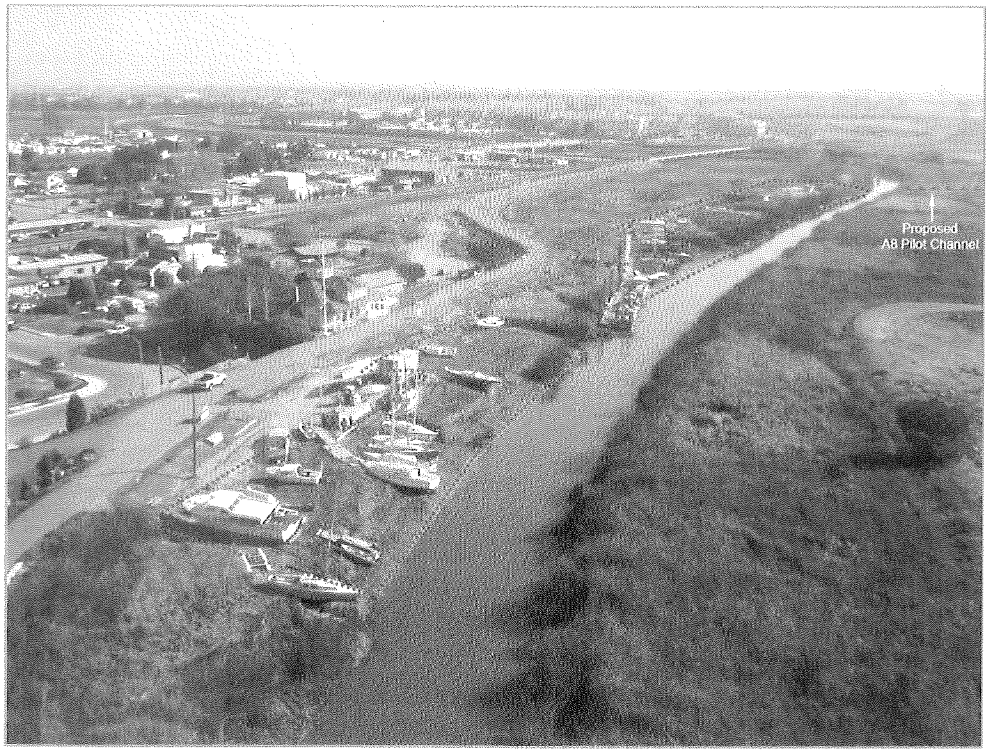
This alternative would result in a loss of 2.6 acres of wetland vegetation, but the amount of mitigation required may be reduced if the SBSP Phase 1 Action operates for several years prior to the Alviso Slough project and scours some of the existing marsh in this alternative's footprint. Furthermore, it is assumed that the 2.6 acres removed under this scenario could ultimately be maintained by scour from the SBSP Phase 1 Action for the life of that project, and thus future impacts from subsequent maintenance activities would be reduced or eliminated. If the SBSP Phase 1 Action is halted, this alternative would result in an initial loss of 2.6 acres of wetland vegetation, which would re-establish itself in the absence of ongoing maintenance. Without the Pond A8 Notch operation, there would be no benefit of reduced mitigation and reduced maintenance, and all related costs would be borne by the Alviso Slough project alone.



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: October, 2007

Figure 4-2. Alternative 1: 2.6 Acres of Vegetation and Root Mass Removal to 4-foot Depth

Before: Dotted lines show outline of proposed vegetation/root mass removal for Alternative 1.



After: At low tide, cleared areas will be exposed mudflats.

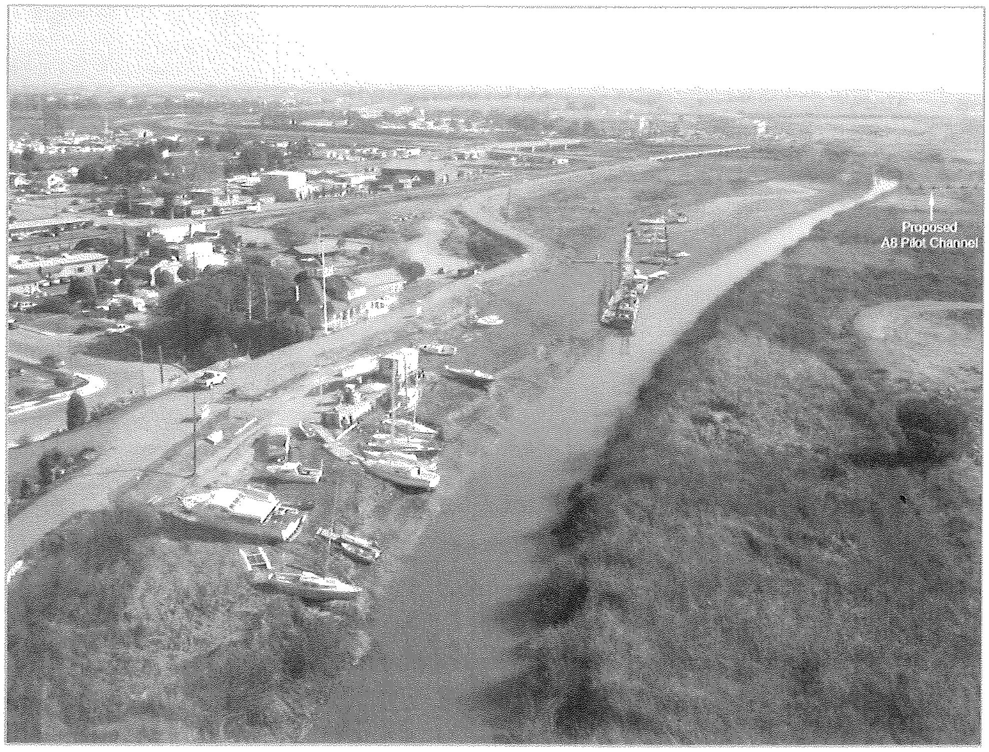


Figure 4-3. Alternative 1: 2.6 acres of Vegetation/Root Mass Removal
Before and After Visual Simulation

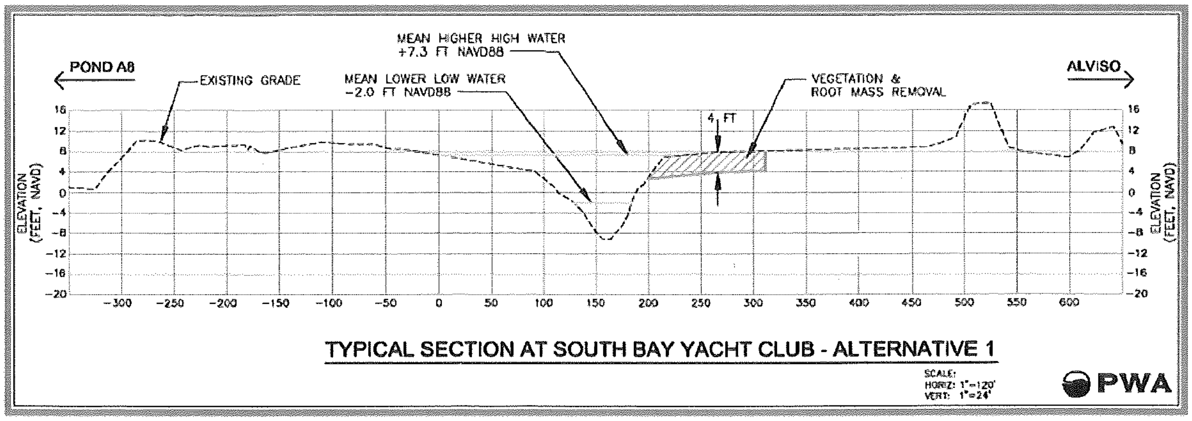


Figure 4-4: Alternative 1: Conceptual Cross-Section Plan for Vegetation/Root Mass Removal

Contaminants of concern in the Alviso Slough channel sediments include mercury, PCBs, legacy organochlorine pesticides, selenium, and trace metals. The increased tidal prism under a successful SBSP Phase 1 project would require efforts to ensure that scour action from that project would not have adverse impacts due to mobilizing contaminants as a result of sediment disturbance from the Alviso Slough Restoration Project. Although the SBSP Phase 1 Action itself may remobilize contaminated sediments, which could reach the far South Bay and/or result in bioaccumulation of mobilized contaminants in the food web, regulatory agencies would likely be concerned that the Alviso Slough Restoration Project would further exacerbate this impact. The South Baylands Mercury Project will continue to monitor impacts in the slough as a result of the SBSP Phase 1 Action and the Pond A8 Notch operations may be adjusted accordingly. Without the SBSP Phase 1 Action, impacts from sediment quality may be slightly less, as post-construction sediment disturbance would be minimized without scour action from the Pond A8 notch.

Possible benefits to water quality as a result of the Alviso Slough Restoration Project include some removal of legacy contaminants in the sediments in the project area. The limited depth (up to 4 feet) of vegetation and root mass removal proposed in this alternative may not provide major benefits of contaminant removal, as the actual amount of sediment removed would be minimal. This would be the case with or without the SBSP Phase 1 Action.

Regulatory Issues

Key agency approvals for this alternative are expected to include the Individual Permit from the USACE with associated Clean Water Act (CWA) Section 404(b)(1) Alternatives Analysis, and a Section 401 Water Quality Certification from the RWQCB. This alternative represents the perceived agency-preferred alternative, as it minimizes impacts to wetland vegetation and confines the impacts to those areas that can most benefit from navigational enhancements (e.g. near the existing South Bay Yacht Club docks).

Based on preliminary discussions with resource agencies, it is believed that a mitigation ratio of 2:1 would be assessed for the loss of wetland vegetation from the vegetation and root mass removal. An estimated cost of $100,000 per acre for wetland mitigation has been assumed for this project.

Hydraulic Impacts

Hydraulic modeling of the Alviso Slough was performed to analyze the effect of 2.6 acres of vegetation and root mass removal along the east side of the slough as shown in Figure 4-2 (Appendix E). This removal would increase the flow conveyance capacity of the slough in this area due to less resistance from vegetation in the channel. During a one-percent event, the post-project condition of the slough would allow conveyance of higher flows, which could overtop the levees along Pond A12 on the east side of the slough downstream of the County Marina and increase the threat of flooding of Alviso via the New Chicago Marsh. To counteract this threat, the existing weir at Pond A8, which is designed to allow overflows from Guadalupe River to the Pond A8 complex during high flow events, would be lowered by 0.5 to 1.0 feet as part of the project work for Alternative 1. The weir modification work would cost approximately $150,000.

Alternative 1 Costs

Costs for vegetation and root mass removal include harvester equipment rental, mobilization and de-mobilization fees, and disposal costs. The preliminary cost estimate for vegetation removal and temporary stockpiling for dewatering purposes is $25,000 per acre. The material removed from the slough would be allowed to dry at the site to shrink its volume, and would be disposed of at a local landfill. After drying, an estimated 8,300 cubic yards of material would be generated for disposal by Alternative 1. Trucking costs and disposal costs for this alternative would be approximately $250,000.

As described earlier, debris, unused docks or piers, and sunken vessels within the Project area would be removed to allow project work to proceed. Approximately $250,000 has been estimated to for this potential work.

Table 4-1 summarizes the preliminary capital and annual maintenance costs for Alternative 1. The costs reflect the more conservative scenario that the SBSP Phase 1 Action is not successful; if the tidal connection created by the Phase 1 Action is operated successfully, the post-project long-term maintenance costs of the Alviso Slough Restoration Project would decreases. Table 4-1 also provides the estimated mitigation costs for removal of 2.6 acres of vegetation and root mass. As stated earlier, a mitigation ratio of 2:1 is being used in the feasible alternatives' evaluation to estimate project costs. If the SBSP Phase 1 Action begins to scour portions of the slough in the Alternative 1 footprint, this restoration project's mitigation requirements (and costs) could be reduced.

The annual O&M costs presented in Table 4-1 reflect the anticipated costs if the SBSP Phase 1 Action is not successful. Over a 10-year maintenance cycle, it is estimated that repetitive removal of vegetation and root mass would be required three times (~$400K x 3 = $1.2M). If the SBSP Phase 1 Action is successful, the resulting scour may reduce the necessity for both frequency and extent of repetitive vegetation and root mass removal.

Annual O&M costs include an estimate for long-term monitoring of the estimated 5.2 acres of mitigation wetlands that would be created as part of this alternative. Currently, District annual monitoring costs for other mitigation projects between 5 and 10 acres in size are approximately $10,000 per acre per year. Mitigation monitoring and reporting would likely be required for a period of 5 years after mitigation is implemented; thus, an estimated cost of $52,000 per year for post-mitigation monitoring for five years would yield approximately $26,000 per year over the 10-year post-construction period.

Table 4-1. Estimated Capital and 10-Year O&M Costs for Alternative 1

	Alternative 1 Project Elements	**Preliminary Capital Costs**	**Preliminary Annual O&M Costs for First 10 Years**
	Design and Permit Acquisition	$300,000	
A	Pre-construction biological surveys	$ 75,000	
B	Clearing/grading of staging areas	$10,000	
C	2.6 acres vegetation and root mass removal	$65,000	
D	Biological monitoring during construction	$15,000	
E	Trucking/disposal of vegetation and root mass	$250,000	
F	Removal of debris/abandoned vessels	$250,000	
G	Modification of Pond A8 Weir	$150,000	
H	Mitigation Costs (5.2 acres @ $100K/acre)	$520,000	$26,000
	Est. Annual O&M Costs (A, C through E every 3 years over 10-yr period)		$120,000
	Subtotal – Rounded Values	**$1.7 M**	**$150,000**
	Contingency (20%)	$ 0.3M	$30,000
	TOTAL (Rounded)	**$2.0 M**	**$180,000/year**

4.2.2 Alternative 2: Vegetation and Root Mass Removal (7.0 acres)

Description

Alternative 2 would remove approximately 7 acres of vegetation and root mass to a depth of 4 feet on both sides of the slough, as shown in Figure 4-5. This alternative would expand on the footprint of Alternative 1 by removing vegetation and root mass on both sides of the slough channel and extending the work from the County Marina to the Gold Street Bridge.

Removal of vegetation and root mass for this alternative would extend approximately 3,400 feet along both sides of the channel. The width of the project work would vary between 40 and 200 feet. The result of project work would increase the average slough open channel width between Gold Street and the County Marina from approximately 50 feet to an average width of about 130 feet.

Figure 4-6 provides "before" and "after" simulated views of the slough for Alternative 2. The rotovation method would be applied for this alternative in the same manner as for Alternative 1. As with Alternative 1, Alternative 2 would require regular maintenance (vegetation and root mass removal using the rotovation method) approximately every 3 years for a period of 10 years, when the SBSP Phase 1 Actions at Pond A8 may be fully implemented. The areas of vegetation removal upstream of the Pond A8 notch channel to the Gold Street Bridge would likely not be scoured by the increased tidal prism and would require ongoing maintenance with or without the Pond A8 Action.

Figure 4-7 presents a conceptual cross-section view of the proposed work in the vicinity of the SBYC. The more extensive removal of vegetation and root mass to a depth of 4 feet would result in a much larger area of exposed mudflats during low tide than Alternative 1. These mudflats would be covered with water during high tide, but, as with Alternative 1, the depth of the slough over the cleared areas would not be significant. While some of the newly loosened sediment (especially in the area opposite the A8 notch) could be transported downstream, a good portion would likely re-deposit in place or on downstream mudflats.

This alternative includes removal debris, unused docks or piers, and sunken vessels within the Project area.

Meets Project Objectives
Alternative 2 represents a footprint for navigational/recreational enhancement that follows the 2004 Board motion – preparing a project for 7 acres of vegetation and root mass removal SCVWD 2004). As with Alternative 1, this Alternative would not restore the width of the slough to pre-1983 conditions, but would expand the width of open channel on both sides of the slough from Gold Street to the Alviso County Marina. Only minimal enhancement to the depth of the slough is expected initially, with most of the area of work expected to be exposed mudflats during low tide, but the areas of vegetation removal would likely be scoured further from the Phase 1 Action at A8. If the SBSP Phase 1 Action is not successful, no benefits of long-term scour would be realized. Additional scour could be realized in the longer term with implementation of subsequent phases of the SBSP Restoration Project over the next decade and beyond.

Sustainability
Tidal scour associated with the proposed SBSP Phase 1 Action at Pond A8 is less likely to sustain this amount of vegetation removal as compared to Alternative 1, especially if the Pond A8 notch is constrained to a minimal opening throughout the life of the Phase 1 project. If notch operations allow for the opening to increase to 40 feet in width, channel widening of approximately 90 feet at the SBYC docks would be expected over time, and this scour would likely sustain more of the vegetation removal conducted for Alternative 2. Until that independent milestone is achieved, however, ongoing mechanical maintenance would be required to sustain the 7-acre footprint of vegetation and root mass removal.

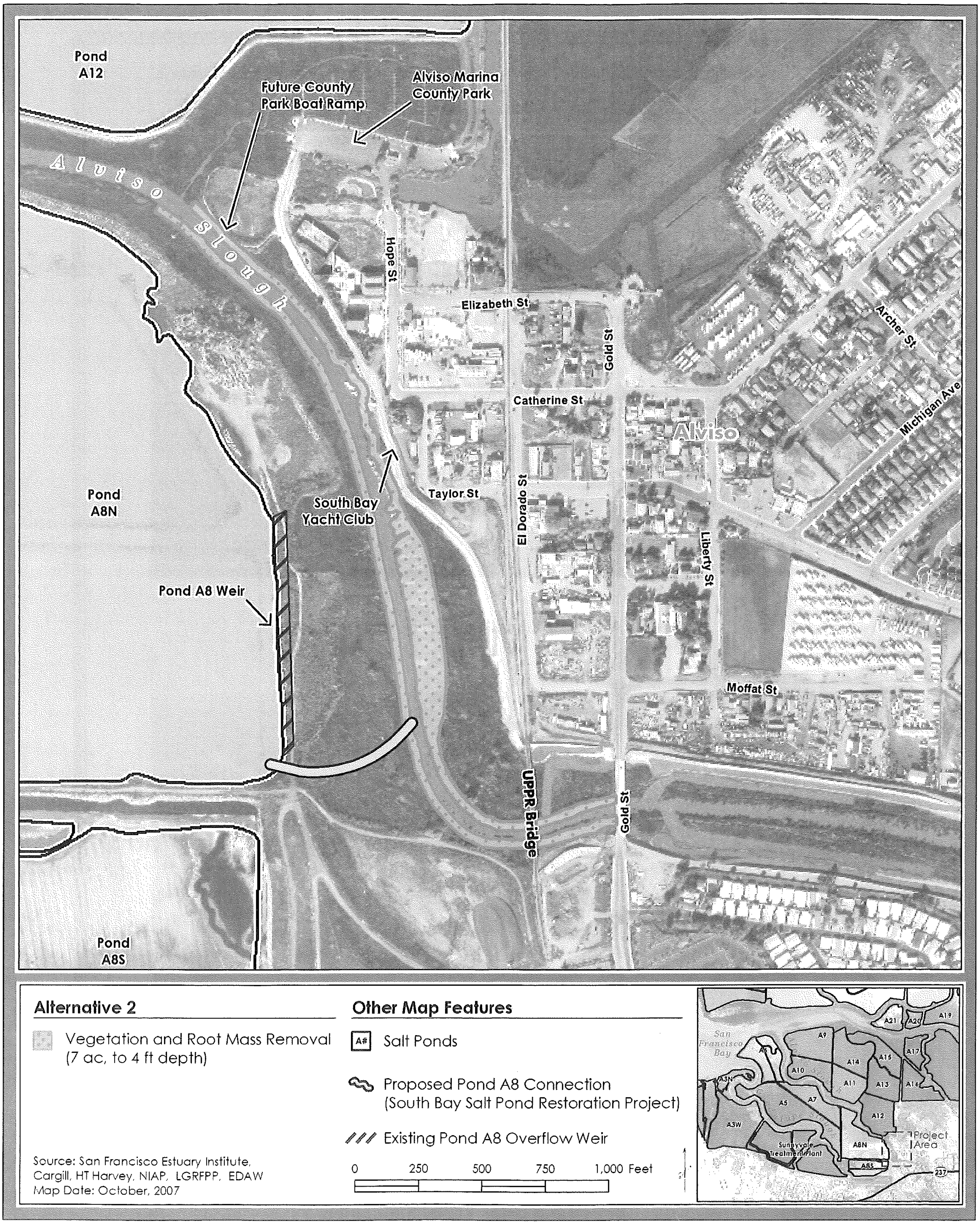
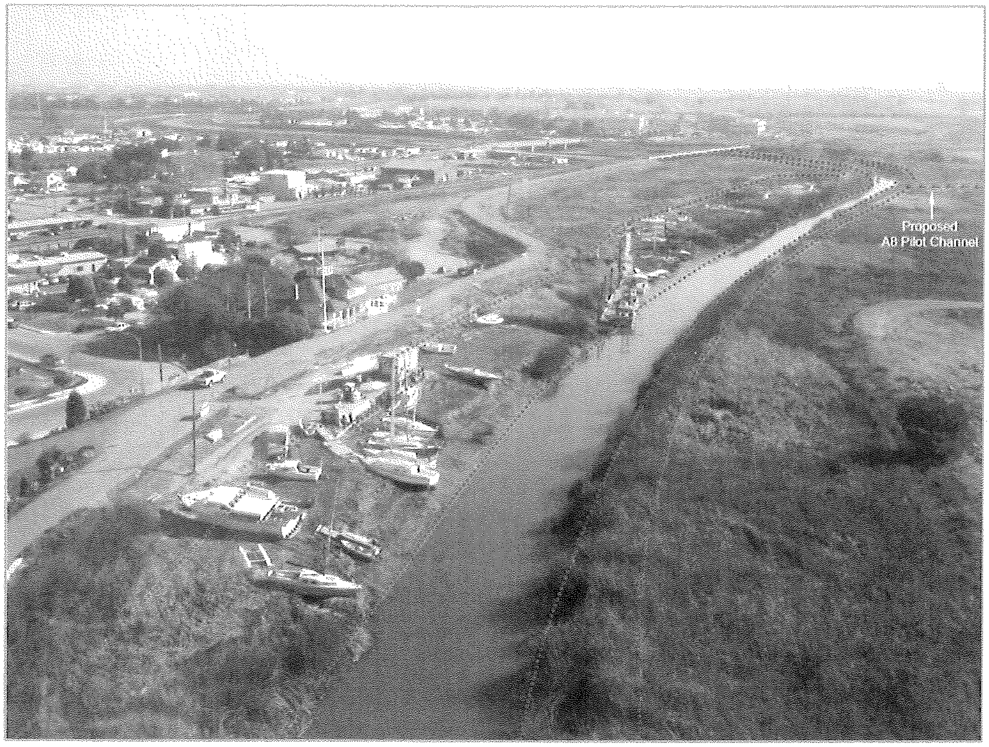


Figure 4-5. Alternative 2: 7.0 Acres of Vegetation and Root Mass Removal to 4-foot Depth

Before: Dotted lines show outline of proposed vegetation/root mass removal for Alternative 2.



After: At low tide, cleared areas will be exposed mudflats.

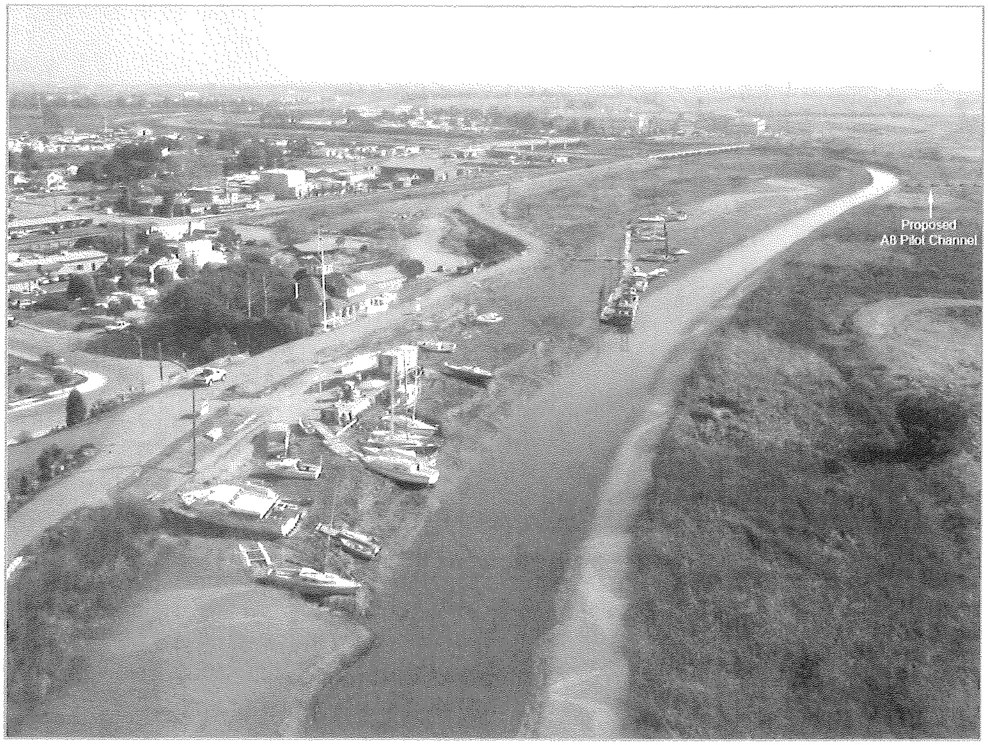


Figure 4-6. Alternative 2: 7.0 acres of Vegetation/Root Mass Removal Before and After Visual Simulation

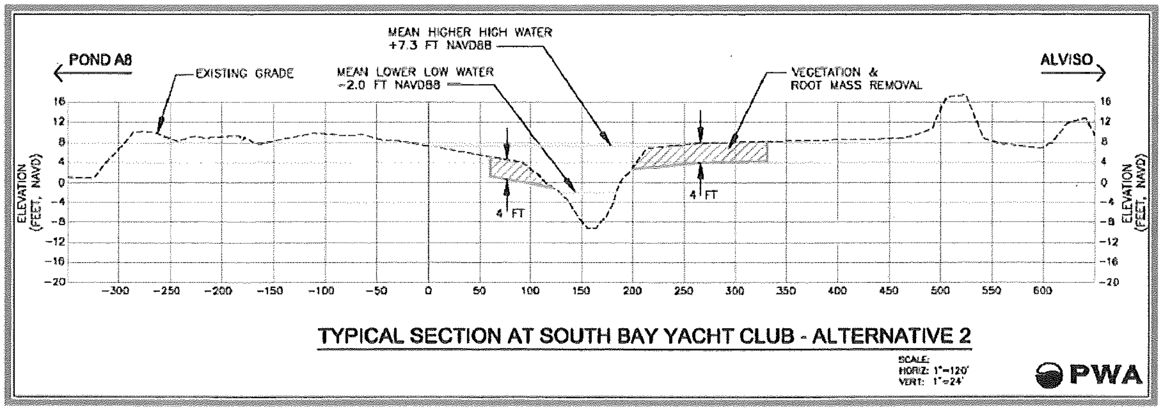


Figure 4-7. Alternative 2: Conceptual Cross-Section Plan for Vegetation/Root Mass Removal

Without the Phase 1 Action, continual maintenance would be required indefinitely as part of the Alviso Slough Restoration Project for the entire 7 acres of vegetation removal. Improvements to navigation in the slough would be short-lived unless vegetation and root mass removal was performed periodically until the slough regime would be changed by the larger SBSP restoration effort.

Environmental Impacts

Alternative 2 would result in a loss of 7 acres of wetland vegetation, which is greater than what is anticipated to scour naturally as a result of the SBSP Phase 1 Action at Pond A8.

The key sediment and water quality impacts of this alternative are generally the same as for Alternative 1. However, temporary impacts during implementation, as well as long-term maintenance practices, could be more widespread given the additional area, and may occur more often given the potential need for additional vegetation maintenance requirements. The potential for mobilization of contaminated sediments, and mitigation requirements for wetland vegetation loss, would be greater than for Alternative 1.

Regulatory Issues

Key agency approvals for this alternative are expected to include the Individual Permit from the USACE and associated Section 404 analysis, and the Section 401 Water Quality Certification from the RWQCB. These agencies have indicated that permits would likely only be issued for activities in areas directly benefiting navigational use. While the additional removal of vegetation proposed in this alternative may be appreciated by users of Alviso Slough and local recreational facilities, regulatory agencies may not view removal of vegetation outside the vicinity of existing docks (e.g. upstream by the UPRR Bridge, or on the west side of the slough) as specifically facilitating navigational opportunities. It may be difficult to justify "purpose and need" of the potential impacts of this alternative to the regulatory agencies. As a worst case scenario, a permit might not be issued.

Hydraulic Impacts

Hydraulic modeling was performed for this alternative and the analysis yielded similar results as for the analysis performed for Alternative 1. The existing weir at Pond A8 would have to be lowered by 0.5 to 1.0 foot as part of the project work for Alternative 2 to maintain a flow split between the overflows to Pond A8 and the remaining flows via Alviso Slough that maintains riverine flood protection to the Alviso area.

Alternative 2 Costs

Table 4-2 summarizes the preliminary cost estimates for Alternative 2. The elements of cost are the same as for Alternative 1, but costs associated with vegetation and root mass removal and disposal, and mitigation requirements, are higher because of the greater extent of vegetation and root mass removal under this alternative. It is estimated that after clearing 7 acres, approximately 22,400 cubic yards of dewatered material would require disposal. The costs for debris and abandoned vessels removal, and the modifications to the Pond A8 overflow weir are the same as for Alternative 1.

Table 4-2. Estimated Capital and 10-Year O&M Costs for Alternative 2

	Alternative 2 Project Elements	Preliminary Capital Costs	Preliminary Annual O&M Costs for First 10 Years
	Design and Permit Acquisition	$500,000	
A	Pre-construction biological surveys	$ 125,000	
B	Clearing/grading of staging areas	$20,000	
C	7 acres vegetation and root mass removal	$175,000	
D	Biological monitoring during construction	$25,000	
E	Trucking/disposal of vegetation and root mass	$673,000	
F	Removal of abandoned vessels/hazards	$250,000	
G	Modification of Pond A8 Weir	$150,000	
H	Mitigation Costs (14 acres @ $100K/acre)	$1,400,000	$70,000
	Est. Annual O&M Costs (A, C through E every 3 years over 10-yr period)		$300,000
	Subtotal (Rounded Values)	**$3.3M**	**$370,000**
	Contingency (20%)	$0.7M	$70,000
	TOTAL (Rounded)	**$4.0M**	**$440,000/year**

The annual O&M costs presented in Table 4-2 are conservative and reflect the anticipated costs if the SBSP Phase 1 Action is not successful. Over a 10-year maintenance cycle, it is estimated that repetitive removal of vegetation and root mass would be required three times (~$950K x 3 = $2.9M). If the SBSP Phase 1 Action is successful, the resulting scour may reduce the necessity for both frequency and extent of repetitive vegetation and root mass removal.

Annual O&M costs include an estimate for long-term monitoring of the estimated 14 acres of mitigation wetlands that would be created as part of this alternative. An annual monitoring cost of $10,000 per acre is assumed. Mitigation monitoring and reporting would likely be required for a period of 5 years after mitigation is implemented; thus, an estimated cost of $140,000 per year ($10K x 14ac) for post-mitigation monitoring for five years would yield approximately $70,000 per year over the 10-year post-construction period.

4.2.3 Alternative 3: Vegetation/Root Mass Removal and Dredging (3.7 acres) to an 8-foot Depth

Description

Alternative 3 would entail removing vegetation and root mass and dredging sediments to a depth of approximately 8 feet below the existing grade over an area of approximately 3.7 acres (Figure 4-8). This alternative was developed with the purpose of balancing the extent of environmental impacts and costs, yet still meeting overall project objectives. The vegetation/root mass removal and dredging is proposed along the east side of the slough to improve access and boating and navigation opportunities. This alternative would widen and deepen the slough channel to allow two-way boat traffic, especially in the area between the South Bay Yacht Club and the Alviso County Marina.

Removal of vegetation and root mass and dredging for this alternative would extend approximately 2,300 feet along the east side of the channel. The width of the project work would vary between 20 and 150 feet. The result of project work would increase the average slough open channel width between Gold Street and the County Marina from approximately 50 feet to an average width of about 100 feet.

An 8-foot depth of dredging would be accomplished through the use of the Aquamog with a clam bucket attachment. The clam bucket has the capability to dredge to a depth of 8 feet and can remove 200-260 cubic yards of sediment per day. Dredging to 8 feet over an area of 3.7 acres would yield approximately 12,000 cubic yards of dewatered vegetation and root mass material, and 60,000 cubic yards of dewatered dredged sediment.

Figure 4-9 provides the "before" and "after" visual simulation for this alternative. Unlike the "after" views for Alternatives 1 and 2, the dredging action for Alternative 3 would result in increased navigability in the slough even during low tide.

As with Alternatives 1 and 2, Alternative 3 would require removal of the abandoned vessels and debris within the Project area and modifications to the Pond A8 overflow weir.

Figure 4-10 presents a conceptual cross-section view of the proposed dredging for this alternative in the vicinity of the SBYC.

Meets Project Objectives

Alternative 3 would provide a significant increase in the width and depth of the slough over existing conditions. While this alternative would not restore the width of the slough to pre-1983 conditions, its focus would be to clear the east side of the slough from the southernmost portion of the South Bay Yacht Club to the Alviso County Marina. If the Phase 1 Action at Pond A8 is successful, the removal of both vegetation and 8 feet of sediments under this alternative would encourage more scour in this area. If the Pond A8 Notch operations are halted, no increased scour would occur in the restored slough until future phases of the SBSP Restoration Project would be implemented. These future phases may ultimately restore the width and depth of the slough to pre-1983 conditions.

Sustainability

Scouring associated with the SBSP Phase 1 Action at Pond A8 would sustain much or all of the width created by dredging 3.7 acres, but not the depth. Implementation of the Pond A8 project may lessen the frequency of maintenance dredging to sustain this dredged depth, but would not eliminate it. Although vegetation would probably not re-colonize quickly in the affected area, sedimentation rates of 1 to 2 feet per year are expected (See Section 2.2.5); thus, dredging would be required approximately every 3 years to sustain the enhanced navigational depth in the slough. Without the SBSP Phase 1 Action at Pond A8, additional dredging would also be required every 3 years to sustain the improved navigational depth in the slough.

Environmental Impacts

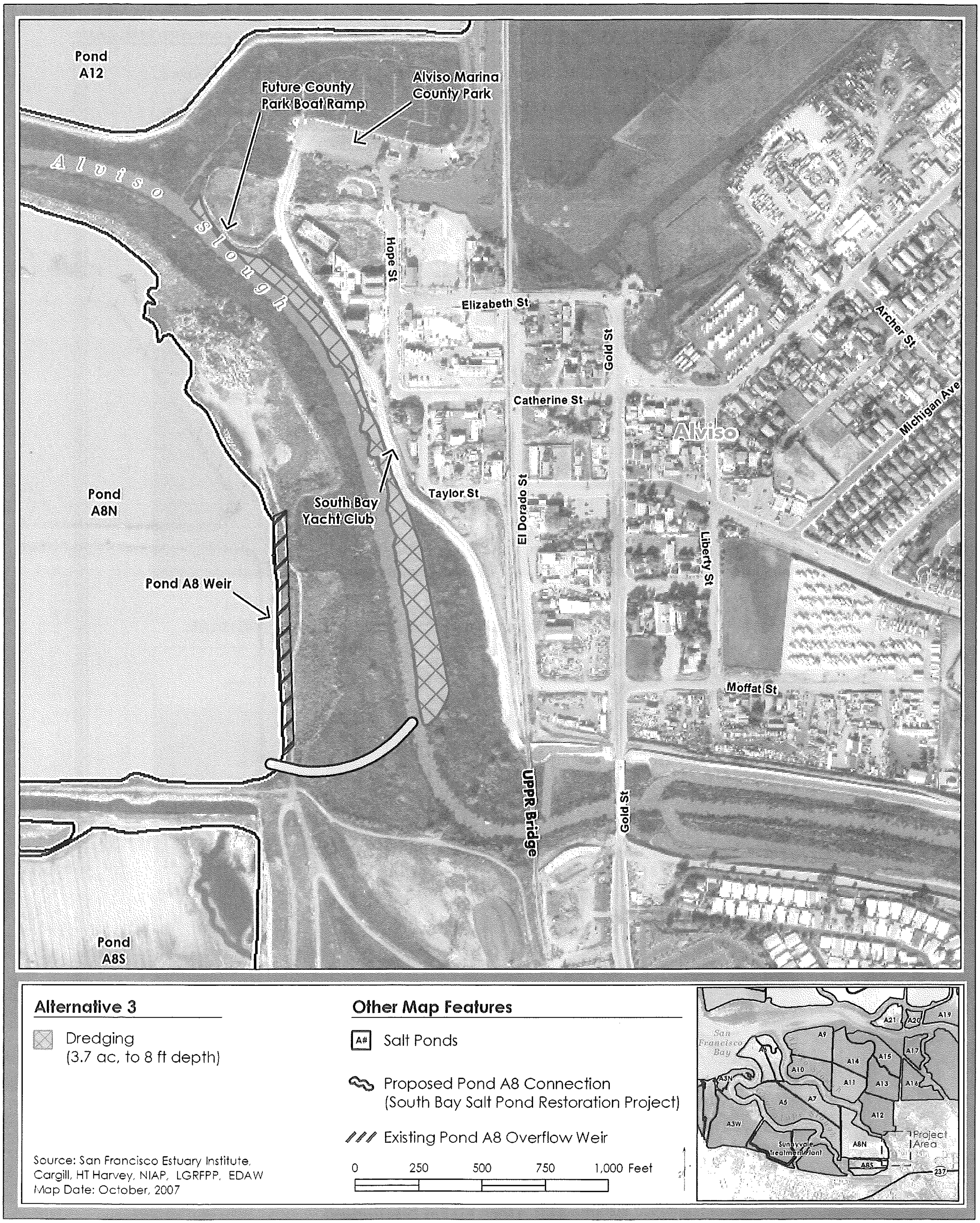
If the Pond A8 Notch operations are halted, Alternative 3 would result in a loss of approximately 3.7 acres of wetland vegetation. As has been stated earlier, the SBSP Phase 1 Action would result in scouring 2 to 5 acres of marshes in the vicinity of this project, depending on the successful management of the notch operations. If the SBSP Phase 1 Action is operates for several years prior to implementation of this restoration project, the environmental impact from the Alviso Slough Restoration Project could be significantly lessened.

Based on sediment data collected in the past year in Alviso Slough, the average concentration of mercury in the sediments is 1,000 parts per billion (ppb). Screening guidelines for re-use of dredged sediment (possibly to help fill Pond A8 or other ponds included in the larger SBSP Restoration Project) limit the mercury concentration to a maximum of 700 ppb. Based on this information, the dredged sediments would likely have to be disposed of at a local disposal facility, such as the Newby Island facility. If pre-construction sediment sampling determines that sediments are highly contaminated with mercury, Polychlorinated biphenyls (PCBs), metals, or other legacy contaminants, the sediments may have to be transported to a special disposal facility. Possible benefits to water quality would occur as a result of removing legacy contamination from the project area.

The project alternatives that include dredging (Alternatives 3, 4 and 5) would require considerable truck hauling to move the dredged sediment from the Project area to the staging areas and finally to the disposal site; the additional truck traffic would result in impacts to local traffic, noise, and air quality.

Regulatory Issues

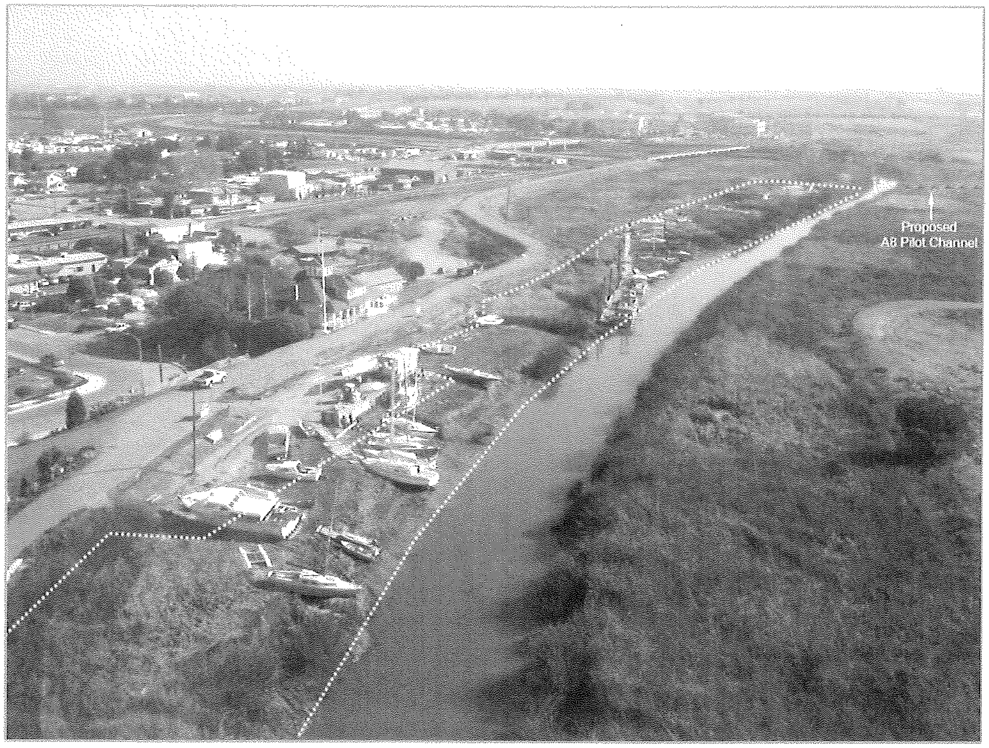
Permits required if Alternative 3 were implemented would include the Individual Permit from the USACE, with the associated Clean Water Act (CWA) Section 404(b)(1) Alternatives Analysis, and a Section 401 Water Quality Certification from the RWQCB. Based on preliminary discussions with these agencies, a dredging alternative may be viewed more favorably than Alternatives 1 or 2 because the benefits to navigation and recreation would be more substantial with the increased depth achieved by the dredging operation.



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: October, 2007

Figure 4-8. Alternative 3: 3.7 Acres of Vegetation and Root Mass Removal and Dredging to 8-foot Depth

Before: Dotted lines show outline of proposed vegetation/root mass removal for Alternative 3.



After: Even at low tide, dredged areas will have adequate depth for 2-way boat traffic.

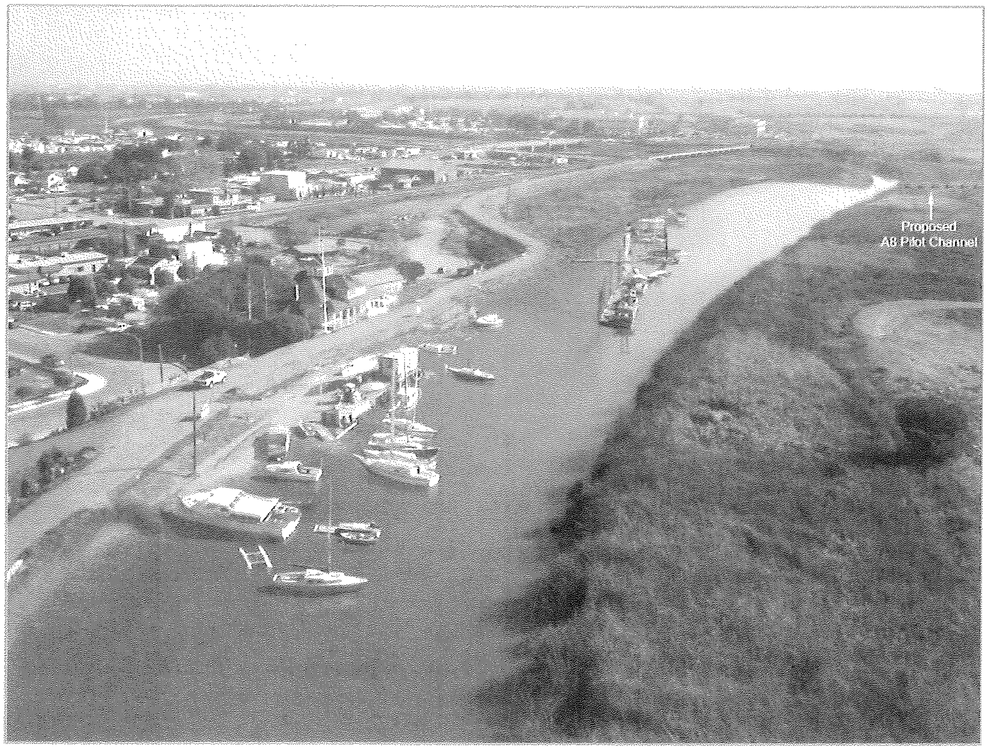


Figure 4-9. Alternative 3: 3.7 acres of Dredging to 8 ft. Depth
Before and After Visual Simulation

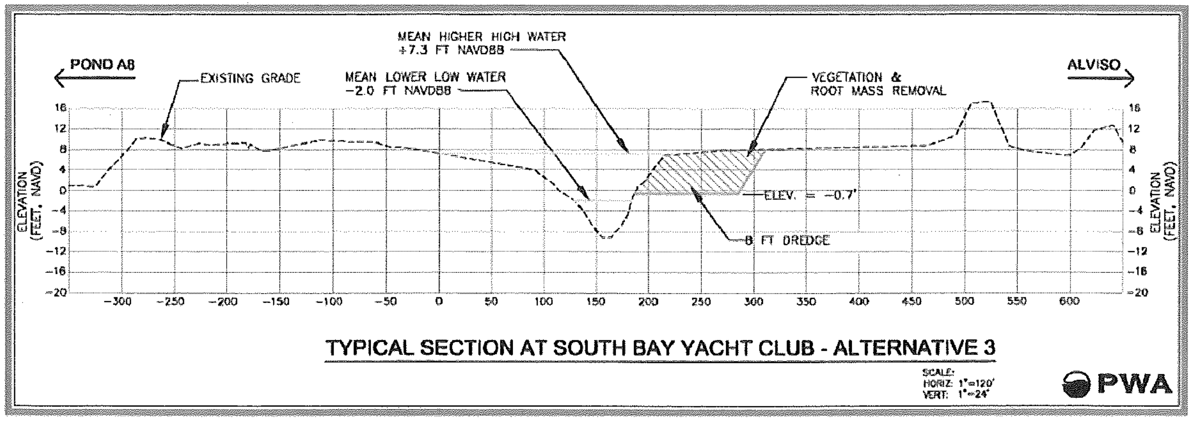


Figure 4-10. Alternative 3: Conceptual Cross-Section Plan for Vegetation/Root Mass Removal and Dredging

Sediment quality, the potential for beneficial re-use of the material, and the location of disposal are all determinants in the permitting of dredging operations. Preliminary test results indicate that the sediment quality in the Slough likely would not meet beneficial re-use requirements (such as at Ponds A8 or A4), which would be preferred by the regulatory agencies. However, disposal of the dredged materials at a local landfill facility should not be an impediment to obtaining a permit for the dredging work.

Because the sediments in Alviso Slough do contain elevated levels of mercury and possibly other contaminants, the RWQCB could view removal of a large quantity of sediment as a secondary project benefit. This issue would not be expected to be a driver of the 401 permit process, and the removal of contaminated sediments would likely not offset the requirements to mitigate for the loss of wetland vegetation.

Hydraulic Impacts

Hydraulic modeling was performed for this alternative, and the analysis yielded similar results as for the analyses performed for Alternatives 1 and 2. The existing weir at Pond A8 would have to be lowered by 0.5 to 1.0 feet as part of the project work for Alternative 3 to maintain existing 1 percent flood protection for Alviso.

Alternative 3 Costs

Table 4-3 summarizes the preliminary cost estimates for Alternative 3. The elements of cost include a combined vegetation/root mass removal/stockpiling and dredging/stockpiling cost of $120,000 per acre. As presented earlier, it is estimated that after dewatering, approximately 12,000 cubic yards of vegetation material would require disposal from clearing 3.7 acres, and dewatered dredged material volume would be approximately 60,000 cubic yards. The cost for abandoned vessels and debris removal and the modifications to the Pond A8 overflow weir are the same as for Alternatives 1 and 2.

Table 4-3. Estimated Capital and 10-Year O&M Costs for Alternative 3

	Alternative 3 Project Elements	Preliminary Capital Costs	Preliminary Annual O&M Costs for First 10 Years
	Design and Permit Acquisition	$500,000	
A	Pre-construction biological surveys and sampling	$0.15M-$0.2M	
B	Clearing/grading of staging areas	$50,000	
C	Dredging and stockpiling (3.7 acres to 8-ft depth)	$444,000	
D	Biological monitoring during construction	$50,000	
E	Trucking/disposal of vegetation and root mass	$369,000	
F	Trucking/disposal of dredged sediment	$2.5M - $7.2M	
G	Removal of abandoned vessels/hazards	$250,000	
H	Modification of Pond A8 Weir	$150,000	
I	Mitigation Costs (7.4 acres @ $100K/acre)	$740,000	$37,000
	Annual O&M Costs (A,C, D, and F every 3 years over 10-yr period)		$1M - $2.4M
	Subtotal (Rounded Values)	**$5.2M - $10M**	**$1.0M - $2.4M**
	Contingency (20%)	$1.0M -2.0M	$0.2M - $0.5M
	TOTAL (Rounded)	**$6.2M – 12.0M**	**$1.2M - $2.9M/yr**

A range of costs is presented for sediment disposal. Pre-construction sediment sampling will be performed to determine the level of mercury and other contaminants in the sediments to be removed as part of this project. The lower cost estimate reflects the trucking and disposal costs if the dredged sediments can be disposed of at a local facility (Newby Island Landfill). If contaminant levels are higher than what Newby Island Landfill can accept, the sediments would likely have to be hauled to a special handling facility. Hauling and disposal costs would be substantially higher in this case, as reflected in the higher value in the presented range.

The annual O&M costs presented in Table 4-3 are conservative and reflect the anticipated costs if the SBSP Phase 1 Action is not successful. Over a 10-year maintenance cycle, it is estimated that repetitive dredging would be required three times (~$3M - $8M x 3 = $9M- $24M), and costs would vary based on the contamination level of the dredged sediments. With a contingency factor, between $1.2M and $2.9M would have to be set aside every year to fund this periodic maintenance dredging. If the SBSP Phase 1 Action is successful, the resulting scour may reduce the frequency of long-term maintenance dredging.

Annual O&M costs include an estimate for long-term monitoring of the estimated 7.4 acres of mitigation wetlands that would be created as part of this alternative. An annual monitoring cost of $10,000 per acre is assumed. Mitigation monitoring and reporting would likely be required for a period of 5 years after mitigation is implemented; thus, an estimated cost of $74,000 per year ($10K x 7.4ac) for post-mitigation monitoring over five years would yield approximately $37,000 per year over the 10-year post-construction period.

4.2.4 Alternative 4: Vegetation/Root Mass Removal and Dredging (6.2 acres) to 16-foot Depth

Description
Alternative 4 would entail removing vegetation and root mass and dredging sediments to a depth of approximately 16 feet below the existing grade over an area of approximately 6.2 acres (Figure 4-11). This dredging depth was developed into an alternative because it would approximate the equilibrium channel depth that is anticipated to be realized in Alviso Slough after implementation of full tidal action in Pond A8, which has been proposed as part of the long-term South Bay Salt Pond Restoration Project.

The proposed footprint of this project alternative includes the east side of the slough in the vicinity of existing docks similar to the earlier alternatives; however, the downstream portion of the proposed footprint covers the west side of the slough. The deepening and widening of the slough was shifted to the west bank in this section of the slough because the fringe marshes are wider, and it is believed that dredging to a depth of 16 feet may compromise the structural integrity of the flood protection levees on the east bank of the slough in this area.

Removal of vegetation and root mass and dredging for this alternative would extend approximately 2,200 feet along the channel. The width of the project work would vary between 100 and 200 feet. The result of project work would increase the average slough open channel width between Gold Street and the County Marina from approximately 50 feet to an average width of about 110 feet. Figure 4-12 presents the "before" and "after" visual simulation for this alternative. As with Alternative 3, the resulting depth of the slough after this extent of dredging would allow increased boat traffic even during low tide.

As with Alternative 3, dredging would be accomplished through the use of the Aquamog with a clam bucket attachment. The working capacity of an Aquamog would be increased and would be most efficient when a combination of the Aquamog and a dragline would be used to offload the sediment. The dragline would work from the levee within 100-foot arcs. The Aquamog would transport all other material from outside those limits to within the dragline's reach for load out. Dredging a 6.2-acre area to a depth of 16 feet would yield approximately 20,000 cubic yards of dewatered vegetation/root mass and 200,000 cubic yards of dewatered dredged material. Figure 4-13 shows the conceptual cross-section of proposed Alternative 4 work in the vicinity of the SBYC.

The extensive volume of material generated for disposal for this alternative would likely require two seasons of work in the channel. The contractor would have to cycle through the use of numerous staging areas near the slough to stockpile the material for dewatering. Assuming ten trucks were employed by the contractor on a daily basis, and each truck completed eight round trips of hauling material to a local disposal facility, approximately 240 days of trucking would be required to remove the estimated volume of dewatered material off site.

As with all alternatives, Alternative 4 would include removal of debris, unused docks and piers, and sunken vessels within the Project area and would also require modifications to the Pond A8 overflow weir to maintain one-percent flood protection through and downstream of the Project area.

Meets Project Objectives

In tandem with the operation of the Pond A8 Notch, Alternative 4 would provide significant expansion of both the width and depth of the slough. While this Alternative would not restore the width of the slough to pre-1983 conditions, it would enhance access for boating and navigation opportunities on the east bank. Two-way boat traffic would be possible along the 2,200 lineal feet of project work, and larger boats could maneuver in the project area.

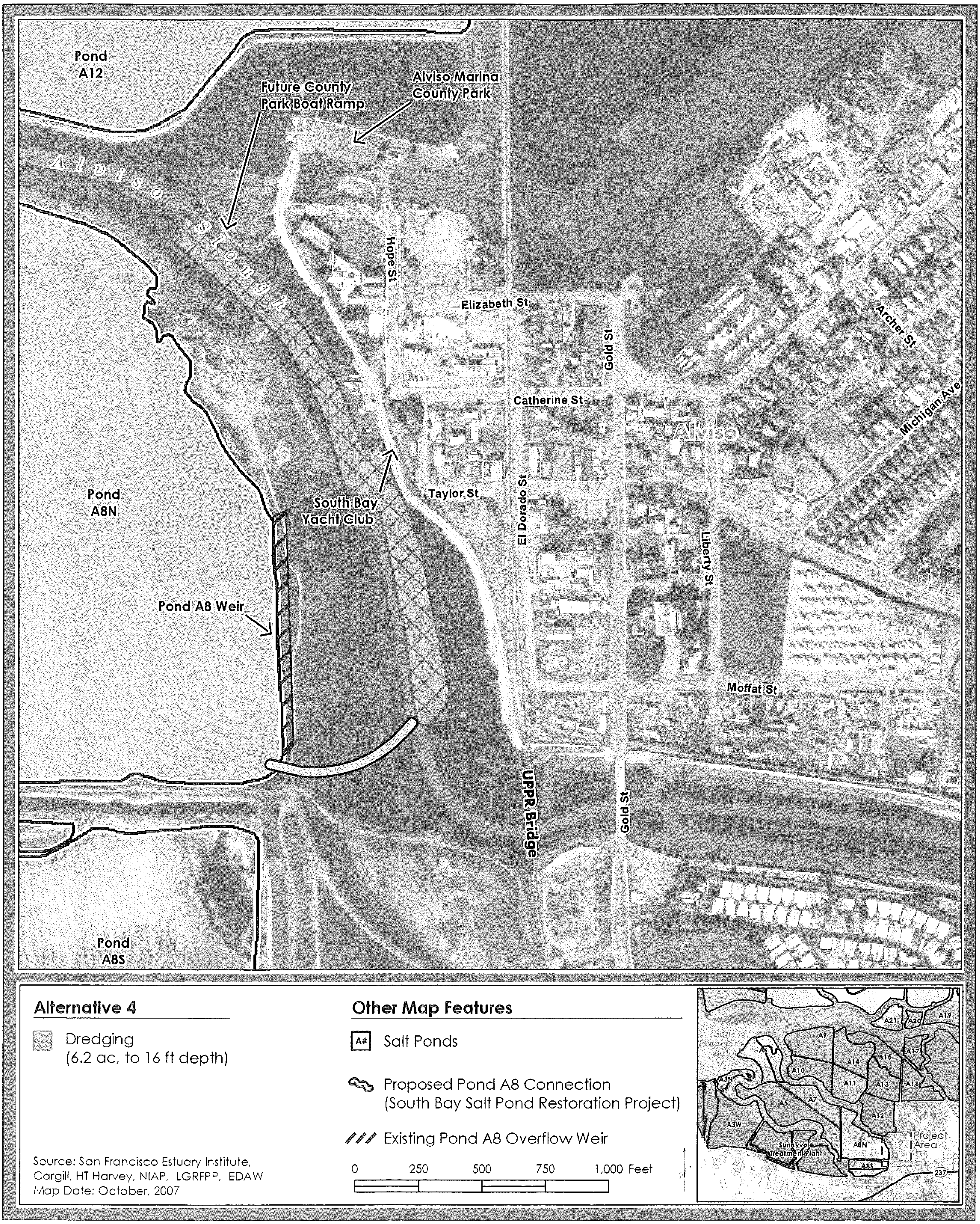
Additional scour may occur in the slough after implementation of future phases of the SBSP Restoration Project over the next decade or more, which could help to achieve the pre-1983 conditions.

Sustainability

A deep dredging effort could provide enhanced navigation benefits for a period of up to 10 years (a 16-foot depth initially, gradually decreasing as sedimentation occurs over time), perhaps until such time as a full breach of Pond A8 is initiated under the long-term SBSP Restoration Project. A full breach is anticipated to induce additional deepening and widening of the slough by tidal scour.

As discussed earlier in this report, successful operation of the Pond A8 Notch would have the potential to sustain a wider channel along Alviso Slough (50 to 90 feet at the SBYC). The footprint of that scour cannot be predicted with complete precision, but an estimated 2 to 5 acres of marsh removal are predicted along Alviso Slough in the Project area.

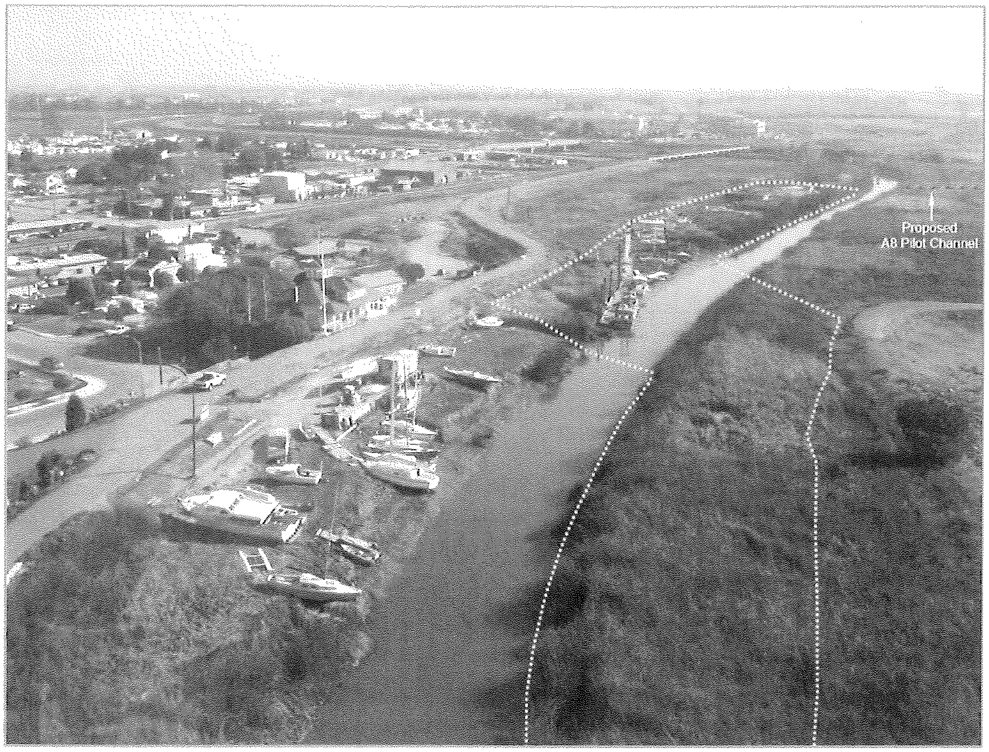
A deep dredging effort with Pond A8 Notch operations could help direct the scour into areas that would enhance recreational boating. While a 16-foot dredge depth could not be sustained by the scour from the SBSP Phase 1 Action alone, it would expand the boating and navigation capacity of the slough. Based on observed sedimentation rates in the former Alviso County Marina of 1 to 2 feet per year in the 1980s (Ruth & Going), a deep dredge of 16 feet below existing grade could delay marsh re-establishment by up to a decade or more. Actual sedimentation rates in areas dredged for the Alviso Slough Restoration Project may differ, due to differences in sediment supply and sediment dynamics between the slough and the former marina.



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: October, 2007

Figure 4-11. Alternative 4: 6.2 Acres of Vegetation and Root Mass Removal and Dredging to 16-foot Depth

Before: Dotted lines show outline of proposed dredging to 16-ft depth for Alternative 4.



After: Even at low tide, dredged area will have adequate depth for 2-way boat traffic.

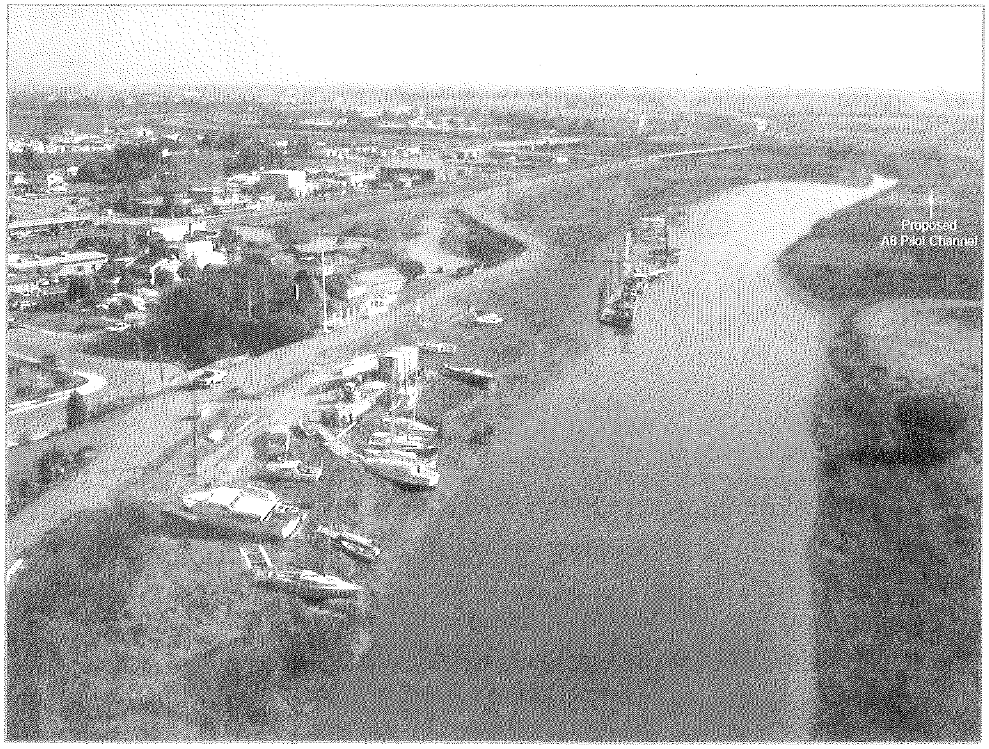


Figure 4-12. Alternative 4: 6.2 acres of Dredging to 16 ft. Depth Before and After Visual Simulation

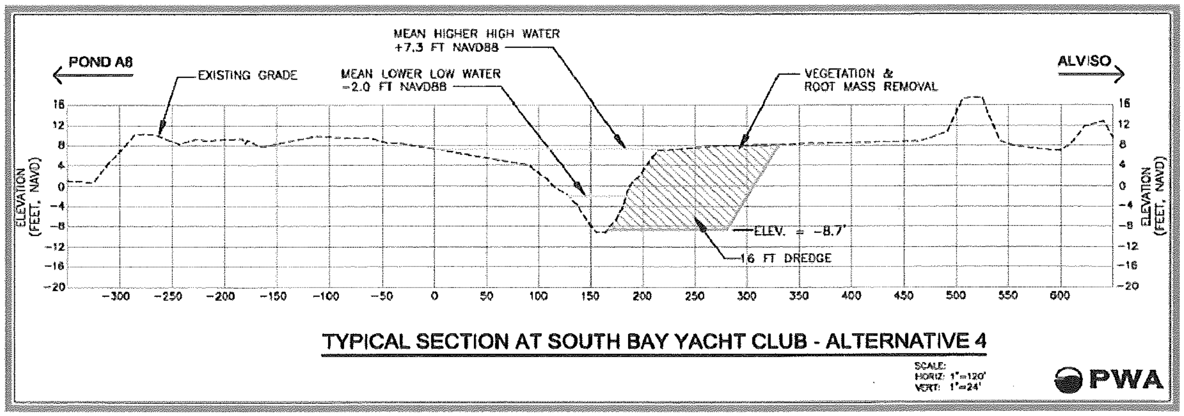


Figure 4-13. Alternative 4: Conceptual Cross-Section Plan for Vegetation/Root Mass Removal and Dredging

Environmental Effects

Without the operation of the Pond A8 Notch, Alternative 4 would result in a loss of approximately 6.2 acres of wetland vegetation. If the SBSP Phase 1 Action is operational for several years in advance of the Alviso Slough Restoration project, it is anticipated that 2 to 5 acres of marshland in the project area would be scoured by the semi-tidal action through the Pond A8 Notch. In such a case, the Project impacts (and associated mitigation requirements) of slough restoration could be greatly reduced.

Similar to Alternative 3, water and sediment quality issues related to dredging are primarily concerned with mobilization of legacy sediment contamination into the slough and the Bay. Dredging would require assessment of contaminant concentrations in deeper sediments and securing appropriate disposal mechanisms. Dredging offers a possible beneficial impact to sediment and water quality by removing legacy sediment contamination.

Based on sediment quality data collected to date and as discussed in the evaluation of Alternative 3, the mercury concentrations in the dredged sediment would exceed guidelines for reuse; thus the dredged sediment would likely be disposed of at a local landfill, such as the Newby Island facility, but may have to be disposed of at a special facility if pre-construction sediment sampling determines that the mercury and/or other contaminant levels exceed what would be accepted at the local landfill. The dredging alternatives (Alternatives 3, 4 and 5) would require significant truck hauling to move the dredged sediment from the Project area to the staging areas and finally to the disposal site; the high volume of truck traffic for Alternative 4 would result in impacts to local traffic, noise, and air quality.

Regulatory Issues

Permits that would be required if Alternative 4 were implemented include the Individual Permit from the USACE with the associated Clean Water Act (CWA) Section 404(b)(1) Alternatives Analysis, and a Section 401 Water Quality Certification from the RWQCB. As stated in the evaluation of Alternative 3, the permitting agencies may view the dredging alternatives more favorably than Alternatives 1 or 2, as the benefits to navigation and recreation are more substantial. However, these agencies have also indicated that permits should only be issued for dredging and/or vegetation removal activities in areas that would achieve direct navigational improvements. A clear argument for the need for 6.2 acres of wetland vegetation removal would be necessary to gain permits for this alternative.

As discussed in the evaluation of Alternative 3, sediment quality, the potential for beneficial re-use of the dredged material, and the location of disposal, are all determinants in the permitting of dredging operations. Disposal of the dredged materials at a local landfill facility should not be an impediment to obtaining a permit for the dredging work.

Because the sediments in Alviso Slough do contain elevated levels of mercury and possibly other contaminants, the RWQCB could view removal of a significant quantity of sediment as a secondary project benefit. This issue is not expected to be a driver of the 401 permit process, and the removal of contaminated sediments would likely not offset the requirements to mitigate for the loss of wetland vegetation.

Hydraulic Impacts
Hydraulic modeling was performed for this alternative and as described in Appendix E, the analysis yielded more dramatic changes to the flow regime in the slough downstream of the Alviso County Marina. To maintain flood protection downstream of the Project area, the existing weir at Pond A8 would have to be lowered by 1 to 2 feet as part of the project work for Alternative 4.

Alternative 4 Costs
Table 4-4 summarizes the preliminary cost estimates for Alternative 4. The elements of cost are the same as for Alternative 3. As presented earlier, it is estimated that after dewatering, approximately 20,000 cubic yards of vegetation material would require disposal after clearing of 6.2 acres, and dewatered dredged material volume would be approximately 200,000 cubic yards. The cost for abandoned vessels and debris removal would be the same as for the previously-described alternatives. Modifications to the Pond A8 overflow weir would be more extensive, and thus, the estimated cost for this work has increased.

The annual O&M costs presented in Table 4-4 are conservative and reflect the anticipated costs if the SBSP Phase 1 Action is not successful. Over a 10-year maintenance cycle, it is estimated that repetitive dredging would be required once. Between \$9.4M and \$25M would have to be set aside in the first 6 or 7 years after project completion to fund the maintenance dredging.

Annual O&M costs include an estimate for long-term monitoring of the estimated 12.4 acres of mitigation wetlands that would be created as part of this alternative. An annual monitoring cost of \$10,000 per acre is assumed. Mitigation monitoring and reporting would likely be required for a period of 5 years after mitigation is implemented; thus, an estimated cost of \$124,000 per year (\$10K x 12.4ac) for post-mitigation monitoring over five years would yield approximately \$62,000 per year over a 10-year post-construction period.

Table 4-4. Estimated Capital and 10-Year O&M Costs for Alternative 4

Alternative 4 Project Elements		Preliminary Capital Costs	Preliminary Annual O&M Costs for First 10 Years
	Design and Permit Acquisition	$500,000	
A	Pre-construction biological surveys and sampling	$0.3M-0.5M	
B	Clearing/grading of staging areas	$90,000	
C	Dredging and stockpiling (6.2 acres to 16-ft depth)	$744,000	
D	Biological monitoring during construction	$115,000	
E	Trucking/disposal of vegetation and root mass	$600,000	
F	Trucking/disposal of dredged sediment	$8.2M - $24.0M	
G	Removal of abandoned vessels/hazards	$250,000	
H	Modification of Pond A8 Weir	$220,000	
I	Mitigation Costs (12.4 acres @ $100K/acre)	$1,240,000	$62,000
	Annual O&M Costs (A, C, D, and F once in a 10-yr period)		$0.96M - $2.5M
	Subtotal (Rounded values)	**$12.2M - $28.2M**	**$1.0M - $2.6M**
	Contingency (20%)	$2.4M - $5.6M	$0.2M - $0.5M
	TOTAL (Rounded)	**$14.6M - $33.8M**	**$1.2M - $3.1M/yr**

4.2.5 Alternative 5: Vegetation/Root Mass Removal (15.3 acres) and Dredging (9.7 acres) to 10-foot Depth

Description

Alternative 5 includes mechanical removal of approximately 15.3 acres of vegetation and root mass to a depth of 4 feet, on both sides of the slough, in addition to dredging sediments over an area of approximately 9.7 acres to 10 feet below the existing grade on both sides of the slough channel (Figure 4-14). This alternative was developed to replicate the pre-1983 conditions in Alviso Slough, as shown in the April 1982 aerial photo (Figure 1-10). As with Alternatives 3 and 4, the 9.7 acres of dredging to 10 feet below existing grade would provide added clearance for larger recreational vessels.

Removal of vegetation and root mass and dredging for this alternative would extend along approximately 3,400 feet of the channel. The width of the project work would vary between 100 and 850 feet. The result of project work would increase the average slough open channel width between Gold Street and the County Marina from approximately 50 feet to an average width of about 160 feet.

Dredging a 9.7-acre area to a depth of 10 feet would yield approximately 200,000 cubic yards of dewatered dredged material, about the same volume as that generated by Alternative 4. Vegetation and root mass removal over a 15.3-acre area would generate approximately 80,000 cubic yards of dewatered material.

Figure 4-15 presents the "before" and "after" visual simulation for Alternative 5. At low tide, all the areas where only vegetation and root mass would be removed would be exposed mudflats. At high tide, they would be covered with shallow water, giving a viewer on the east bank levee near the UPRR Bridge an open-water view across the entire slough.

Figure 4-16 presents a conceptual cross-section view of the slough area affected by work under this alternative.

Periodic maintenance would be required approximately every 3 years (possibly less frequently for the dredged areas) until SBSP Phase 1 Actions at Pond A8 are fully implemented, estimated at up to 10 years, and perhaps ongoing thereafter in those areas not scoured by the Phase 1 Action.

Alternative 5 would include the removal of debris, unused docks or piers, and sunken vessels within the Project area, and would also require modifications to the Pond A8 overflow weir to maintain one-percent flood protection through and downstream of the Project area.

Meets Project Objectives

Alternative 5 reflects the maximum footprint for navigational/recreational enhancement of all alternatives being considered. It would restore the open water width and depth of the slough to pre-1983 conditions. Alternative 5 is the only action evaluated that would fully meet all of the project objectives.

Sustainability

As discussed earlier in this report, the SBSP Phase 1 Action at Pond A8 has the potential to sustain a wider channel along Alviso Slough (50 to 90 feet at the SBYC). The footprint of that scour cannot be predicted with complete precision, but an estimated 2 to 5 acres of marsh removal are predicted along Alviso Slough in the project area. Given this projection, the Pond A8 Notch operations would likely not sustain much of the proposed 25 acres of marsh removal for Alternative 5; thus, regular maintenance would be required.

A 10-foot dredge depth could not be sustained by the scour from the SBSP Phase 1 Action alone. However, a dredging effort concurrent with the observed effects of the Pond A8 Notch operations could help direct the scour into areas that would enhance recreational boating. Based on observed sedimentation rates in the former Alviso County Marina of 1 to 2 feet per year in the 1980s (Ruth & Going), a dredge of 10 feet below existing grade could delay marsh re-establishment by 3 to 5 years or more (a 10-foot depth initially, gradually decreasing as sedimentation occurs over time).

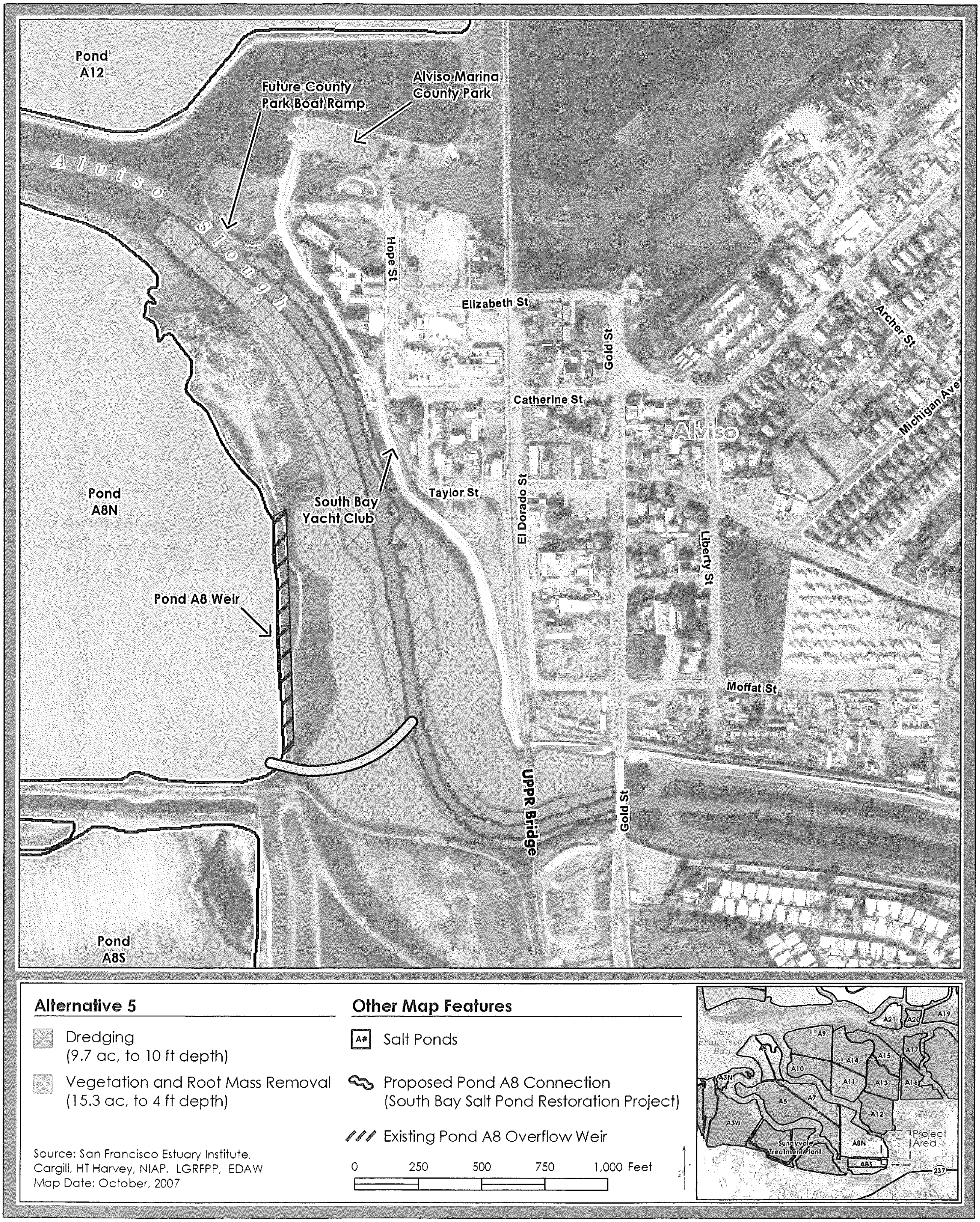
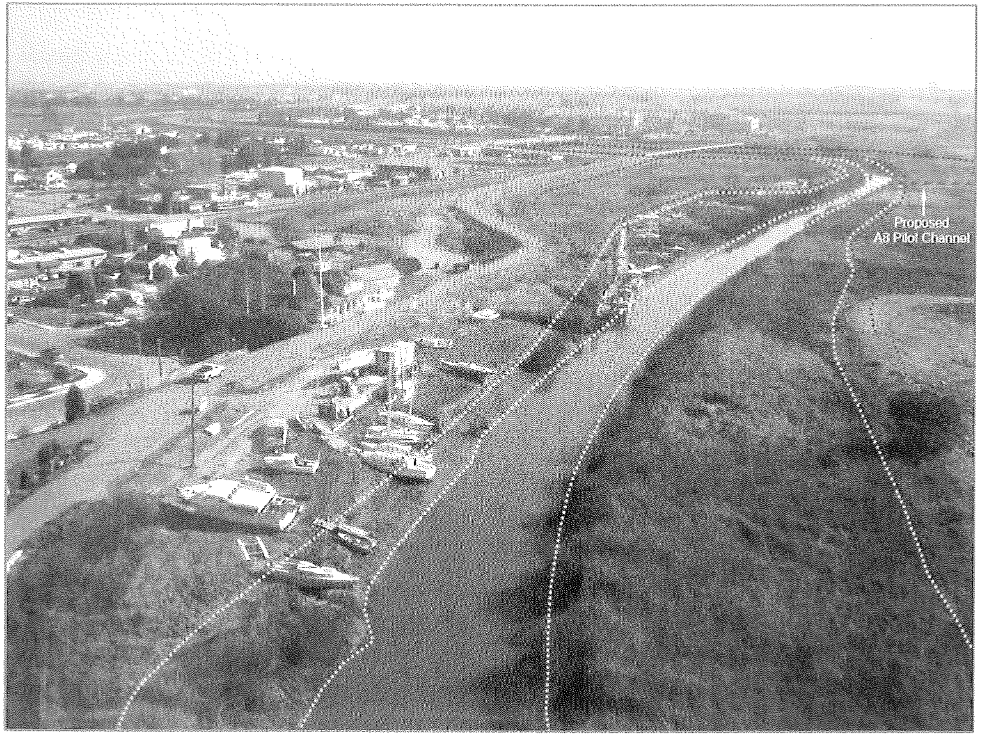


Figure 4-14. Alternative 5: 15.3 Acres of Vegetation and Root Mass Removal and 9.7 acres of Dredging to 10-foot Depth

Before: Dotted lines show outline of proposed vegetation/root mass removal and dredging to 10 ft. depth for Alternative 5.



After: Cleared area reflects pre-1983 slough conditions. Areas where only vegetation/root mass were removed are exposed mudflats at low tide.

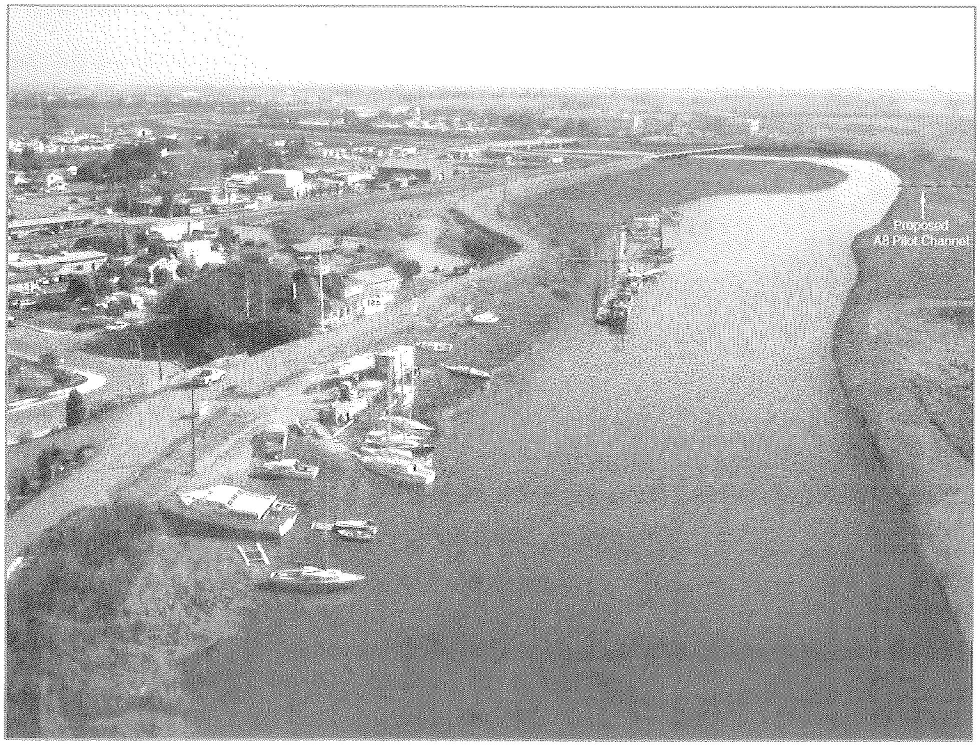


Figure 4-15. Alternative 5: 15.3 Acres of Vegetation/Root Mass Removal and 9.7Acres of Dredging to 10 ft. Depth - Before and After Visual Simulation

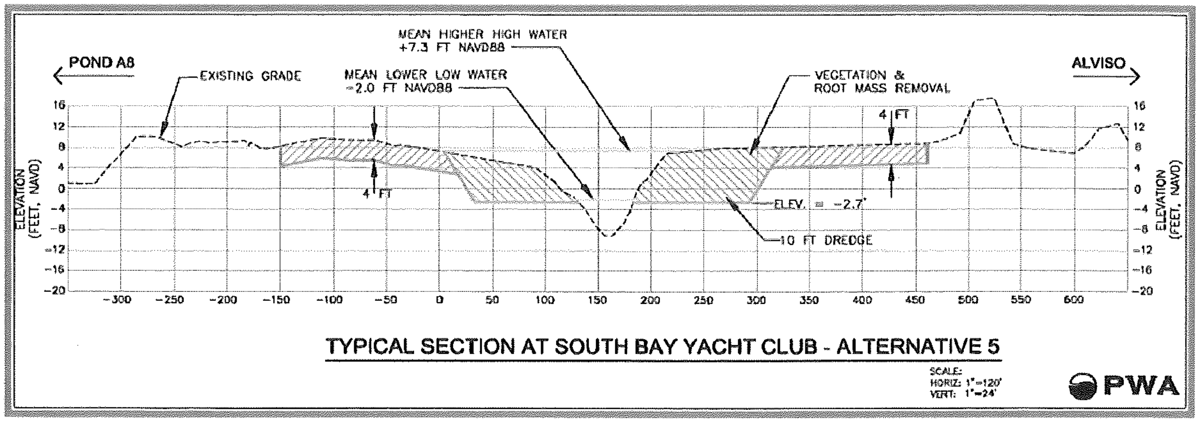


Figure 4-16. Alternative 5: Conceptual Cross-Section Plan for Vegetation/Root Mass Removal and Dredging

Environmental Effects

Alternative 5 would result in a loss of approximately 25 acres of wetland vegetation. With the SBSP Phase 1 Action preceding the Alviso Slough Restoration project, it is anticipated that 2 to 5 acres of marshland in the project area may be scoured by the semi-tidal action through the Pond A8 notch. In such a case, the Project impacts (and associated mitigation requirements) of slough restoration could be reduced.

As with the other alternatives, water and sediment quality issues related to dredging are primarily about mobilization of legacy sediment contamination into the slough and the Bay. Dredging creates the need to assess contaminant concentrations in deeper sediments and find appropriate disposal mechanisms. Extensive dredging would offer a possible beneficial impact with respect to sediment and water quality by removing legacy sediment contamination.

Based on sediment quality data collected to date, the mercury concentrations in the dredged sediment would exceed guidelines for reuse; thus the dredged sediment would be disposed of at a local landfill, such as the Newby Island facility, or possibly at a special handling facility, if pre-construction sediment sampling determines that mercury and/or other contaminant concentrations are higher than acceptable at the Newby Island facility. The dredging alternatives (3, 4 and 5) would require extensive truck hauling to move the dredged sediment from the Project area to the staging areas and finally to the disposal site; the additional truck traffic would result in impacts to local traffic, noise, and air quality.

Regulatory Issues

Permits that would be required if Alternative 5 is implemented include the Individual Permit from the USACE with the associated Clean Water Act (CWA) Section 404(b)(1) Alternatives Analysis, and a Section 401 Water Quality Certification from the RWQCB. As stated in the evaluation of Alternative 3, the permitting agencies may view the dredging alternatives more favorably than vegetation removal alone, because the benefits to navigation and recreation are more substantial. However, these agencies have also indicated that permits should only be issued for dredging and/or vegetation removal activities in areas that would achieve direct navigational improvements. A clear argument for the need for 25 acres of wetland vegetation removal would be necessary to gain permits for this action.

Preliminary test results indicate that the sediment quality in the Slough likely would not meet beneficial re-use requirements (such as at Pond A8), which is preferred by the regulatory agencies. However, disposal of the dredged materials at a local landfill facility should not be an impediment to obtaining a permit for the dredging work.

Because the sediments in Alviso Slough do contain elevated levels of mercury and possibly other contaminants, the RWQCB could view removal of a significant quantity of sediment as a secondary project benefit. This issue is not expected to be a driver of the 401 permit process, and the removal of contaminated sediments would likely not offset the requirements to mitigate for the loss of wetland vegetation.

Hydraulic Impacts

Hydraulic modeling was performed for this alternative and the analysis yielded similar anticipated changes to the flow regime in Alviso Slough in the vicinity of the Alviso County Marina and along Pond A12 during periods of high flows. To maintain flood protection downstream of the project area, the existing weir at Pond A8 would have to be lowered by 1 to 2 feet as part of the project work for Alternative 5.

Alternative 5 Costs

Table 4-5 summarizes the preliminary cost estimates for Alternative 5. The elements of cost are the same as for Alternatives 3 and 4, with the added element of only vegetation and root mass removal to a depth of 4 feet over an area of 15.7 acres. As presented earlier, it is estimated that after dewatering, approximately 80,000 cubic yards of vegetation material would require disposal after clearing 15.3 acres, and dewatered dredged material volume would be approximately 200,000 cubic yards. The cost for abandoned vessels and debris removal would be the same as for the previously-described alternatives. Modifications to the Pond A8 overflow weir would be more extensive, and thus, the estimated cost for this work has increased.

The annual O&M costs presented in Table 4-5 are conservative and reflect the anticipated costs if the SBSP Phase 1 Action is not successful. It is estimated that additional dredging would be required twice in every 10-year maintenance cycle. Between \$3.4M and \$7.1M would have to be set aside every year after project completion to fund the maintenance dredging and disposal.

Annual O&M costs include an estimate for long-term monitoring of the estimated 50 acres of mitigation wetlands that would be created as part of this alternative. An annual monitoring cost of \$10,000 per acre is assumed. Mitigation monitoring and reporting would likely be required for a period of 5 years after mitigation is implemented; thus, an estimated cost of \$500,000 per year (\$10K x 50ac) for post-mitigation monitoring over five years would yield approximately \$250,000 per year over a 10-year post-construction period.

Table 4-5. Estimated Capital and 10-Year O&M Costs for Alternative 5

	Alternative 5 Project Elements	Preliminary Capital Costs	Preliminary Annual O&M Costs for First 10 Years
	Design and Permit Acquisition	$500,000	
A	Pre-construction biological surveys and sampling	$0.35M-0.5M	
B	Clearing/grading of staging areas	$90,000	
C	Vegetation/root mass removal and stockpiling	$625,000	
D	Dredging and stockpiling (9.7 acres to 10-ft depth)	$1,164,000	
E	Biological monitoring during construction	$100,000	
F	Trucking/disposal of vegetation and root mass	$2,397,000	
G	Trucking/disposal of dredged sediment	$8.1M - $23.9M	
H	Removal of abandoned vessels/hazards	$250,000	
I	Modification of Pond A8 Weir	$220,000	
J	Mitigation Costs (50 acres @ $100K/acre)	$5,000,000	$250,000
	Annual O&M Costs (C, E, F, and ½A three times in 10 years; D, E, G, and ½A two times in 10 years)		$2.6M - $5.7M
	Subtotal (Rounded values)	**$18.8M - $34.7M**	**$2.8M - $6.0M**
	Contingency (20%)	$3.8M - $6.9M	$0.6M - $1.2M
	TOTAL (Rounded)	**$22.6M - $41.7M**	**$3.4M - $7.1M/yr**

4.2.6 No Project

Description

Under the No Project alternative, the District would take no action to widen or deepen Alviso Slough between Gold Street and the Alviso County Marina. Ongoing District maintenance activities (such as flood protection levee maintenance, etc.) and mowing of vegetation in the area around Gold Street and the UPRR bridges would continue under current management direction and under current permits.

Meets Project Objectives

This alternative does not meet project objectives, with the exception of maintaining one-percent flood protection.

Anticipated Outcome

If the SBSP Phase 1 Action is successful over the long term, tidal scour in Alviso Slough would likely increase the current channel width by 50 to 90 feet in the vicinity of the SBYC, and deepen the channel invert. These changes would be self-sustaining as long as tidal exchange between Pond A8 and Alviso Slough continued. A successful Phase 1 Action combined with no action taken by the District would provide a benefit to recreation and improve navigation over time, and require no mitigation on the part of the District.

Successful implementation of Phase 1 and favorable findings from the South Baylands Mercury Project would increase the possibility of full tidal restoration at Pond A8. Over the long term (perhaps 10 years or more), this larger SBSP restoration project would further increase navigation opportunities along Alviso Slough.

If no action is taken by the District and the Phase 1 Action at Pond A8 is not successful, existing patterns of channel narrowing would continue, and in the upper (landward) reach of Alviso Slough, the channel thalweg (the deepest part of the channel) would continue to deepen. The rates of these changes would gradually diminish until the channel reached an equilibrium depth and width. Navigation would likely not improve, and freshwater vegetation would continue to thrive along the low flow channel.

Environmental Effects

The No Project alternative would result in zero loss of wetland vegetation, and no mitigation would be required as a result of the Alviso Slough Restoration Project. If the SBSP Phase 1 Action at Pond A8 is successful, the slough is expected to scour as described in the previous paragraphs. The SBSP Project would be responsible for all mitigation and maintenance costs.

The SBSP Phase 1 Action at Pond A8 alone would narrow the focus of sediment and water quality issues to remobilization of legacy contaminants due to increased tidal energy and induced scour from that project. The South Baylands Mercury Project would continue to monitor impacts in the slough as a result of the SBSP Phase 1 Action and adjust operations of the Pond A8 Notch accordingly.

Alternatives Summary

Table 4-6 presents a summary comparison of elements and analyses for the five action alternatives for the Alviso Slough Restoration Project and the analyses, including capital costs and annual O&M costs for the first 10-year post-project maintenance cycle.

Table 4-6. Feasible Alternatives Summary Screening Matrix

	Alt. 1 Vegetation and Root Mass Removal (2.6 acres)	Alt. 2 Vegetation and Root Mass Removal (7.0 acres)	Alt. 3 Vegetation and Root Mass Removal With Dredge to 8-foot depth (3.7 acres)	Alt. 4 Vegetation and Root Mass Removal With Dredge to 16-foot depth (6.2 acres)	Alt. 5 Vegetation/Root Mass Removal (15.3 acres) to 4-foot depth and Dredging (9.7 acres) to 10-foot depth	Alt. 6 No Project
Project Elements						
Length of slough affected by project work (ft)	1,400	3,400	2,300	2,200	3,400	0
Width of slough affected by project work (ft)	30 - 100	40 - 200	20 - 150	100 - 200	100 - 850	0
Current avg. slough between Gold St. & County Marina (ft)[1]	50	50	50	50	50	50
Post-project avg. slough width between Gold St. & County Marina (ft)[2]	80[3]	130	100	110	160	50[3]
Meets Project Objectives						
With SBSP Phase 1	Is a first step to restoring slough width/ habitat to pre-1983 conditions. Meets other project objectives. Navigational enhancement limited to very low draft recreational vessels	Same as Alternative 1. Navigational enhancements limited to very low draft recreational vessels over a greater area than Alt. 1, including future County boat ramp	Same as Alternative 1. Navigational enhancements expanded to mid-size vessels at high tide.	Same as Alternative 1. Navigational enhancements expanded to larger size vessels at low and high tide.	Approximates width and depth of the slough to pre-1983 conditions. This alternative meets all project objectives	Does not meet project objectives.
Without SBSP Phase 1	Same as above; however, does not promote the integration with the Salt Pond Restoration Program.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Meets all project objectives except promoting integration with SBSP	Does not meet project objectives.

Table 4-6. Feasible Alternatives Summary Screening Matrix (cont'd)

	Alt. 1 Vegetation and Root Mass Removal (2.6 acres)	Alt. 2 Vegetation and Root Mass Removal (7.0 acres)	Alt. 3 Vegetation and Root Mass Removal With Dredge to 8-foot depth (3.7 acres)	Alt. 4 Vegetation and Root Mass Removal With Dredge to 16-foot depth (6.2 acres)	Alt. 5 Vegetation/Root Mass Removal (15.3 acres) to 4-foot depth and Dredging (9.7 acres) to 10-foot depth	Alt. 6 No Project
Sustainability, Environmental Impacts, Regulatory Issues						
Boating and recreation enhancement						
With SBSP Phase 1	Slough channel widened for access (east bank only); existing docks suitable for berthing at high tide; minimal additional depth.	Slough channel widened for access (east and west banks); existing docks suitable for berthing at high tide; Negligible navigation benefits from vegetation removal upstream of existing docks. Minimal additional depth.	Slough channel widened for access (east bank only); Channel width increased along 2,300 LF of slough; 2-way boat traffic allowed.	Slough channel widened for access (east + west banks) and for 2-way boat traffic; channel width increased by ~75 ft along 2,200 LF of slough.	Slough channel widened on both sides. Channel depth improved on both banks along 3,400 LF of slough.	Improvement to existing boating and recreation access may be realized over time form Pond A8 Notch operations.
Without SBSP Phase 1	Same as above	Same as above	Same as above	Same as above	Same as above	Navigation access continues to diminish over time.
Sustainability						
With SBSP Phase 1	Area of vegetation removal very likely to be sustained by A8 notch scour.	Area of vegetation removal less likely to be sustained by A8 scour. Vegetation removal near UPPR and Gold Street Bridges would not be sustainable.	All or most of vegetation removal area likely to be sustained by A8 notch scour; dredged areas would require re-dredging every 3 years.	Area of vegetation removal only partially sustained by A8 notch scour; dredged areas would sustain expanded navigation for about 10 years.	Area of vegetation removal only partially sustained by A8 notch scour; dredged areas would sustain expanded navigation for about 3-5 years.	n/a
Without SBSP Phase 1	Cannot be sustained without regular maintenance.	Same as Alternative 1.	Same as Alternative 1.	Same As Alternative 1.	Same As Alternative 1.	n/a
Environmental Impacts						
With SBSP Phase 1	Footprint minimizes impacts to wetlands and water quality.	Larger footprint increases impacts to wetlands and water quality.	Impacts greater due to addition of dredging. Potential benefits to water quality realized through removal of sediments containing legacy contaminants.	High potential impacts to water quality due to volume of material being moved. Potential benefits to water quality realized through removal of sediments containing legacy contaminants.	Greatest potential impacts to water quality due to volume of material being moved. Potential benefits to water quality realized through removal of sediments containing legacy contaminants.	n/a

Table 4-6. Feasible Alternatives Summary Screening Matrix (cont'd)

	Alt. 1 Vegetation and Root Mass Removal (2.6 acres)	Alt. 2 Vegetation and Root Mass Removal (7.0 acres)	Alt. 3 Vegetation and Root Mass Removal With Dredge to 8-foot depth (3.7 acres)	Alt. 4 Vegetation and Root Mass Removal With Dredge to 16-foot depth (6.2 acres)	Alt. 5 Vegetation/Root Mass Removal (15.3 acres) to 4-foot depth and Dredging (9.7 acres) to 10-foot depth	Alt. 6 No Project
Without SBSP Phase 1	If the SBSP Phase 1 Action is not implemented, the environmental impacts for each alternative as described above would be the same. Without the scour potential of the SBSP Phase 1, less sediment would be suspended in the slough to migrate to the South Bay.					n/a
Regulatory Issues						
With SBSP Phase 1	Generally more favorable with than without SBSP; more favorable as project is limited to areas with direct improvements to recreational boating and navigation, and is within the area to be scoured by the Phase 1 Action at A8.	Generally more favorable with than without SBSP. Less favorable for the areas beyond the area of Phase 1 Pond A8 scour, and those areas not providing specific benefits to recreational boating and navigation (such as upstream portion of Project area near UPPR and Gold Street Bridges).	Generally more favorable with than without SBSP. More rigorous data and pre-construction surveys likely required for dredging alternative. More favorable as project is limited to areas with direct improvements to recreational boating and navigation, and is within the area to be scoured by the Phase 1 Action at A8.	Generally more favorable with than without SBSP. More rigorous data and pre-construction surveys likely required for dredging alternative. Less favorable for the areas beyond the area of Phase 1 Pond A8 scour, and those areas not providing specific benefits to recreational boating and navigation.	Generally more favorable with than without SBSP. More rigorous data and pre-construction surveys likely required for dredging alternative. Less favorable for the areas beyond the area of Phase 1 Pond A8 scour, and those areas not providing specific benefits to recreational boating and navigation.	n/a
Without SBSP Phase 1	Permitting would be a challenge; but limiting action to areas in vicinity of existing docks still more favorable to agencies.	Permitting would be a challenge, especially in areas beyond those providing specific recreational boating or navigation enhancements.	Permitting only slightly more difficult than Alt. 1, as long-term navigation and public access benefits are maximized by dredging.	Same as Alternative 3.	Same as Alternative 2	n/a

Table 4-6. Feasible Alternatives Summary Screening Matrix (cont'd)

	Alt. 1 Vegetation and Root Mass Removal (2.6 acres)	Alt. 2 Vegetation and Root Mass Removal (7.0 acres)	Alt. 3 Vegetation and Root Mass Removal With Dredge to 8-foot depth (3.7 acres)	Alt. 4 Vegetation and Root Mass Removal With Dredge to 16-foot depth (6.2 acres)	Alt. 5 Vegetation/Root Mass Removal (15.3 acres) to 4-foot depth and Dredging (9.7 acres) to 10-foot depth	Alt. 6 No Project
Estimated Capital Costs						
Est. Capital Cost (w/ 20% contingencies)	$2.0M	$4.0 M	$6.2M - $12M	$14.7M - $33.9M	$22.6M - $41.7M	0
Estimated Annual Maintenance Cost Over First 10 Years[4]						
Est. Annual Maintenance Costs if SBSP Phase 1 Action is not successful	$180,000	$440,000	$1.2M - $2.9M	$1.2M - $3.1M	$3.4M - $7.1M	0

[1] Average width of slough before and after implementation of alternatives was based on approximately 10-equi-distant transects between Gold Street and the County Marina. Current average width of open water based on field measurements on February 1, 2007.

[2] Resultant width of slough after construction does not imply adequate depth for all boats at all tides. The widths do not include changes associated with the SBSP Phase 1 Action (see footnote 3).

[3] The Alternative 1 and No Project values of 80 and 0, respectively, do not consider the SBSP Phase 1 actions. The SBSP Phase 1 Action is predicted to increase the average width of the slough between Gold Street and the County Marina by 50 to 90 feet, or to an estimated slough width of 100-140 feet, and resultant average width of 120 feet. Such action could potentially increase the resultant widths of Alternatives 1 and 6 as shown in this table. The other alternatives are predicted to attain a channel width as shown with or without the SBSP Phase 1 Action.

[4] The annual maintenance costs over the first ten years after project implementation include a 20% contingency. With SBSP Phase 1 Action implemented, the annual maintenance costs may be less than the estimates presented for Alternatives 1 through 4. Refer to discussion in the evaluation of each alternative for more detailed information.

4.3 Ranking of Action Alternatives – Draft Engineer's Report

The five feasible action alternatives were ranked using two categories of criteria: community-based criteria and technical criteria. Since this project was initiated and the planning study carried out through a collaborative process, the community-based criteria consisted of 1) to what extent an alternative meets the project objectives; and 2) the community's preference among the feasible alternatives. The community-based criteria were given a 50 percent weight in the alternatives evaluation.

Technical criteria are typical of capital project evaluation criteria. They address cost-effectiveness, project sustainability, and environmental impacts. The technical criteria were also assigned a 50 percent weight in the evaluation process.

Table 4-7 summarizes the alternatives evaluation criteria and the weights that were assigned for the ranking process.

Table 4-7. Evaluation Criteria and Assigned Weights for Ranking Alviso Slough Restoration Project Alternatives

Evaluation Criteria	**Weight**
Community-Based Criteria	
1. Meets Project Objectives	
a. Restore to pre-1983 condition	8
b. Improve navigation, access, recreation	8
c. Maintain 1 percent flood protection	8
d. Reduce mosquito nuisance	1
e. Promote integration w/ SBSP for salt-water Connections	5
2. Community Preference	20
Technical Criteria	
3. Cost-Effectiveness	
a. Capital costs	7
b. Long-term Operations & Maintenance Costs	8
4. Environmental Impacts	20
5. Project Sustainability	15
Total	100

Based on the project team's evaluation, and giving an equal 50-50 weight between the community-based criteria and capital project technical criteria, Alternative 5 was the highest-ranked alternative followed by Alternatives 1, 3, 4, and 2.

4.4 Revised Staff-Recommended Alternative for Final Engineer's Report

In June 2008, the Draft Engineer's Report and Draft EIR were released for a 45-day public review and comment period. In July 2008, a public hearing was held to obtain public input and oral comments on both draft documents. At the public hearing, nearly 70 attendees expressed support for the Staff-Recommended Alternative 5.

Several comment letters from various regulatory agencies submitted during the public review period for the Draft EIR raised concerns about 1) the initial and ongoing disturbance to habitat from regular maintenance dredging and vegetation removal; 2) disturbance and potential migration of mercury-contaminated sediments by both the initial project work and long-term maintenance activities; and 3) potential uptake of exposed contaminated sediment by the biota.

Some stakeholder groups also expressed concerns about the environmental impacts of the proposed project, and the financial and schedule impacts to other District projects or programs if both the initial capital investment and long-term maintenance funds would be appropriated for the proposed project.

Revised Staff-Recommended Alternative

Based on the comments received on the Draft EIR and subsequent meetings with several resource agencies, staff is revising its recommended alternative from Alternative 5 to Alternative 3. Alternative 3 would include vegetation and root mass removal over 3.7 acres, and dredging within that same footprint to a depth of 8 feet. This alternative was originally developed with the purpose of balancing the extent of environmental impacts and costs, yet still meeting overall project objectives.

Phased Approach to Implementing Staff-Recommended Alternative

In addition to reducing the footprint of work (and environmental impacts) for the proposed project, using a phased approach to implement the project would further address the regulatory agencies' concerns. By the end of summer 2010, the Pond A8 Notch construction is anticipated to be completed, and the notch is expected to begin operating in spring 2011. Staff recommends that a portion of the 3.7-acre footprint of the proposed Alternative 3 slough restoration project be cleared of vegetation and dredged to a depth of 8 feet in 2012, one year after the Pond A8 Notch operations begin. Depending on the extent of observed channel scour after the initial portion of work, the District would determine locations where additional mechanical removal of vegetation and root mass, and sediment dredging, would best assist the action of the notch to gradually widen and deepen the slough. Removing vegetation or dredging on just a portion of the proposed Alternative 3 footprint would be less costly and less environmentally intrusive.

4.5 Summary

Five feasible action alternatives were developed and evaluated with regard to meeting project objectives, project sustainability, regulatory issues, environmental impacts, hydraulic impacts, and estimated capital and Operations & Maintenance costs.

The footprint of affected area where either vegetation/root mass and/or sediment dredging would be performed between the Gold Street Bridge and the Alviso County Marina ranged from 2.6 acres

(Alternative 1) to 25 acres (Alternative 5). Three alternatives included dredging slough sediments to depths ranging from 8 feet to 16 feet below existing grade.

The estimated capital costs among the five alternatives ranged from $2.0M (Alternative 1) to $22.6M - $41.7M (Alternative 5). The capital cost estimates included creation of mitigation wetlands to compensate for the loss of wetlands from the project. A 2:1 mitigation ratio has been used, and would require from 5.4 acres of wetland mitigation for Alternative 1 up to 50 acres for Alternative 5.

Long-term O&M costs were evaluated for a 10-year post-project period. Estimated annual O&M costs ranged from $0.2M per year (Alternative 1) to $3.4M - $7.1M per year (Alternative 5) depending on where the sediments generated by ongoing dredging can be disposed. The O&M costs do not account for ongoing scour that may occur in the slough if the proposed SBSP Phase 1 Action at Pond A8, a muted tidal connection, is implemented and is successful. Annual O&M costs for each alternative would likely be reduced if the Phase 1 Action is successful, though at this time the reduction is difficult to quantify.

Alternatives were initially evaluated and ranked using both community-based and technical criteria. However, after the Draft EIR and Draft Engineer's Report were circulated for public review, and several letters of comments expressed serious concerns with the proposed alternative, staff has revised its recommended alternative from Alternative 5 to Alternative 3, and has proposed a phased approach to implementing this alternative, to capitalize on the tidally-induces scour from the operations of the Pond A8 Notch, to be constructed by summer 2010 as part of the South Bay Salt Ponds Restoration Project's Phase 1 Action, and to reduce environmental impacts and both capital and long-term maintenance costs.

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Chapter 5
Recommended Alternative – Description of Work

5.1 Description of Work

5.1.1 Description of Actions

The recommended alternative would remove vegetation and root mass and dredge sediments to a depth of 8 feet below the existing grade over an area of approximately 3.7 acres. This work would widen and deepen the slough channel to allow two-way boat traffic to operate at all periods of the tidal cycle along 2,300 lineal feet of the east bank of the slough, aligning with existing docks and planned access (Alviso Marina County Park boat ramp).

The recommended alternative would include the removal of debris from the Project Area, including abandoned vessels, unused docks, and sunken vessels, if not already resolved by the Bay Conservation and Development Commission (BCDC), California State Lands Commission (CLSC), the District, and the South Bay Yacht Club (SBYC). All procedures would follow the California Department of Boating and Waterways guidelines for abandoned boat removal.

Removal of vegetation and root mass would be performed around and under the existing active docks and piers on the east side of Alviso Slough within the Project Area. If piers or docks are damaged or displaced in the process, they would be re-installed after completion of work.

The existing overflow weir along Pond A8, an element of the Lower Guadalupe River Flood Protection Project work (2002-2004) is located in the area of work for the recommended alternative. The Pond A8 weir is designed to divert a portion of the 1 percent flow in Alviso Slough to Pond A8 (and Ponds A5, A6, A7, and Guadalupe Slough) to decrease peak discharges and water surface elevations downstream of the Alviso County Marina. Hydraulic modeling has been performed as part of this project planning work to assess flood impacts of each alternative. The effect of clearing and dredging over a 3.7-acre area would deepen and widen the slough channel and would alter the existing balance of 1 percent flood flows between overflows to Pond A8 and flows conveyed through Alviso Slough to the Bay. Removal of the vegetation and widening and deepening of the slough channel would reduce existing friction factors, and higher flows would be conveyed past the weir and down Alviso Slough. These higher flows would increase the flood threat to Alviso, as they would more likely overtop the existing levees along Pond A12, and could flood Alviso via the New Chicago Marsh.

To maintain 1 percent flood protection for Alviso, the Pond A8 weir would be lowered via soil excavation and grading so as to maintain the existing flow split between weir flows to Pond A8 and flows conveyed via Alviso Slough. The hydraulic modeling analysis indicates that the Pond A8 weir would have to be lowered by up to 1 foot across some of its 1,100-foot extent to maintain the existing 1 percent flow split.

The following description of work assumes that the entire 3.7-acre project footprint would be cleared and dredged in one effort.

- It is estimated that vegetation/root mass removal would proceed at a rate of 0.5 acre per day per one Aquamog machine. In-channel work to extricate the vegetation/root mass and place it on various staging sites along the slough for dewatering and hauling would require approximately 8-10 working days, including mobilization and demobilization of equipment.
- It is estimated that vegetation/root mass removal would yield approximately 3,200 c.y. of plant material per acre. Vegetation/root mass removal over 3.7 acres would yield approximately 12,000 c.y. of wet plant material.
- Dredging to a depth of 8 feet below existing grade over an area of 3.7 acres would yield approximately 48,000 c.y. of wet dredged sediment. When removed to staging areas for dewatering, an applied expansion factor of 25% would yield approximately 60,000 c.y. of material. It is estimated that one Aquamog machine would remove approximately 230 c.y. of slough sediment per day. If five Aquamogs are deployed simultaneously for dredging operations, they would generate approximately 1,150 c.y. of dredged sediment per day. It would take approximately 40–45 working days to remove 48,000 c.y. of sediment from the slough.
- The timing and pace of either vegetation/root mass or sediment removal would also depend on available land along the slough for interim stockpiling and dewatering, the length of time required for sediment to be adequately dewatered, and the number of trucks that would operate to haul the material to either the Zanker Road or the Newby Island landfill facilities. Initial estimates indicate close to 5,000 truck trips would be required for dredged sediment disposal only. If 80 truck trips per day haul the dredged materials, the hauling and disposal would take approximately 60-65 working days.

Table 5-1 summarizes the estimated work effort and time for the above-described elements of vegetation/root mass removal and dredging over a total of 3.7 acres.

Staff has recommended that implementation of the vegetation/root mass and sediment removal work be phased over multiple years to reduce costs and to coordinate with the tidally-induced scour of the slough that is anticipated to occur in the next several years after construction of the South Bay Salt Pond Restoration Project's Phase 1 Action at Pond A8 (Pond A8 Notch). Phasing the work in tandem with the deepening and widening of the slough from the Pond A8 Notch operations could result in several work efforts over a 3- to 10-year period. The extent of vegetation removal and/or dredging for each of these efforts cannot be predicted at this time, but would likely be of shorter duration and may generate smaller volumes of vegetation and sediment for disposal than described above.

Table 5-1. Implementation of Staff-Recommended Alternative In One Action (No Phasing of Work)

Work Element	Recommended Alternative
Areal extent of vegetation/root mass removal	3.7 acres
Vegetation/root mass removed	12,000 c.y.[1, 2]
Work duration – Vegetation/root mass removal only	10 days[3]
Haul trips to disposal facility – Plant material only	1,000 round trips
Hauling duration – Plant material only, assuming 80 trips per day	12-15 Days[4]
Areal extent of dredging to 8 feet below existing grade	3.7 acres
Volume of sediment removed (wet)	48,000 c.y.
Volume of sediment after dewatering (25% "fluff factor")	60,000 c.y.
Work duration – Dredging only (1,150 c.y./day)	40-45 days[3] (8-9 weeks)
Haul trips to disposal facility – Dredged sediment only	5,000
Hauling duration – Dredged sediment only, assuming 80 trips per day	60-65 days (12-13 weeks)[5]
Total estimated work duration (working days)	10+65=75 days[5]
Total Estimated work duration (months)	4
Staging/Stockpiling area required	3-5 acres[6]

Notes:

1. c.y. = cubic yard.
2. Vegetation/root mass removal yields ~3200c.y. per acre
3. Work duration assumes 0.5 acre/ day vegetation/root mass removal per Aquamog, and 230 c.y./day dredged material per Aquamog.
4. Hauling duration assumes an average of 80 round-trips per day (this would double to 160 per day if plant material and dredged sediment are hauled simultaneously for a period of time), 5 days a week, using 12c.y. capacity haul trucks. The hauling duration for sediment incorporates a 10-day dewatering period.
5. Hauling of vegetation to Zanker Road Landfill would overlap with hauling of sediment to Newby Island Landfill. If all the sediment had to be disposed of in a special facility due to high contaminant levels, the number of trucks used for hauling would have to be doubled to complete the disposal in the same number of days.
6. Sediment would be stockpiled in 2-6-foot high layers. Plant material stockpiling is assumed to be up to 9 feet high initially, which would decrease as the vegetation is dewatered.

5.1.2 Maintenance

As describe in Chapter 2, observed sedimentation rates in the slough are anticipated to average 1–2 feet per year, as documented for the former Alviso County Marina (Ruth & Going, 1980) Actual sedimentation rates in areas dredged for the Alviso Slough Restoration Project could differ due to differences in sediment supply and sediment dynamics.

If the SBSP Phase 1 Action at Pond A8 is halted or is unsuccessful, the 8-foot dredging effort could provide enhanced navigation benefits for a period of about 2-3 years. The depth of dredging would initially be 8 feet below existing grade, but the open channel depth would gradually decrease over time due to sedimentation from both upstream sources and the Bay. It is assumed that 3 additional dredging actions to restore the initial 8 feet of depth would be required over a 10-year post-project cycle to maintain the navigational benefit.

Successful implementation of the Phase 1 Action (the Pond A8 Notch) has the potential to sustain a somewhat wider channel along Alviso Slough (estimated at 50 to 90 feet wide at the SBYC), but likely would not sustain the dredged 8-foot depth of this project effort. The precise footprint of the proposed SBSP Phase 1 Action scour cannot be predicted, but it is estimated that approximately 2 to 5 acres of marsh would be removed along Alviso Slough in the Alviso Slough Restoration Project Area by the implementation of the muted tidal regime via the Pond A8 notch.

Since implementation of the recommended alternative for the Alviso Slough Restoration Project will occur after the SBSP Phase 1 Action is operational, it could direct the added scour into areas that would enhance recreational boating, thus helping to maintain some (but not all) of the new channel width.

5.1.3 Construction Equipment, Schedule, Sequencing

5.1.3.1 Overall Construction Schedule

If the Board of Directors elects to fund the staff-recommended alternative for the Alviso Slough Restoration Project, the following milestones have been developed as the next steps toward project implementation:

- EIR certification and Engineer's Report approval: November 2009
- Completion of permit acquisition: July 2011
- Slough restoration – no phasing: June 2012
- Phased slough restoration: June 2012 and later dates to be determined

The progress of clearing vegetation/root mass and dredging sediments would be limited by the number of pieces of equipment that could operate in the slough at any one time, the size, location, and availability of necessary contractor staging and stockpiling areas, and regulated hours and seasons for construction work. Construction equipment and staging areas are described in the following subsection.

Regulated seasons for in-channel work is the primary limiting factor for the pace of work. Constraints on the work schedule would also include avoidance of the nesting season for birds (spring and early summer), the rearing and migration seasons for fish (spring and winter), and the rainy winter season. The annual work window is therefore assumed to be approximately June 15 to October 15[1], but would be determined by the appropriate regulatory agencies during the permitting process. Daily work hours, including all work in the slough and hauling of materials, could be limited to avoid or minimize impacts upon the community.

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[1] The regulatory agencies may limit the construction window to August – October if presence of the California clapper rail is a concern, with some possibility of being allowed to work in the slough in February and March. In this case, vegetation removal could occur in March, followed by sediment removal between August and October.

5.1.3.2 Construction Equipment

Construction Equipment and Workers

Heavy equipment would be used for removal of vegetation and dredged material, to move the material from the slough to stockpiling/dewatering areas, and ultimately to the disposal locations. Construction equipment would include Aquamogs, excavators, dozers, and haul trucks in and around Alviso Slough (see Table 5-2).

Table 5-2. Typical Construction Equipment to be Used for the Alviso Slough Restoration Recommended Alternative 3

Type of Equipment	Role	Qty. Needed
Aquamog	Excavate vegetation and/or sediment from slough	1
Harvester	Excavate vegetation and/or sediment from slough, gather rotovated material	1-2
Crane/Excavators	Load haul trucks	2
Loader/Dozer	Manage material at staging area; aid in loading material onto haul trucks	3
Conveyor Trailers	Shoreline transfer to haul trucks	2
Haul Truck, 10-wheel (~12 c.y.)	Haul material from construction area to disposal facility	15-20
Crane/Transfer Barge	Move sediment in the slough within Project Area	5
Pile Driver	Re-install piers (if needed)	1

Construction workers would be on-site each business day during the construction period. Generally, there would be one operator for each piece of equipment in Table 5-2 in addition to a construction site manager. Workers would find street parking around the SBYC. Personnel performing biological monitoring, regulatory agency personnel, and District staff would be on-site periodically.

Best Management Practices for Construction

The District's 2008 Best Management Practices Handbook provides a complete list of SCVWD BMPs and references. Applicable measures are incorporated into a project design by reference, with the primary purpose being to avoid, prevent, or minimize adverse environmental impacts. The BMPs address impacts relating to:

- Air Quality;
- Biological Resources;
- Cultural Resources;
- Hazards & Hazardous Materials;
- Hydrology/Water Quality;
- Noise;

- Transportation/Traffic; and
- Utilities/Service Systems

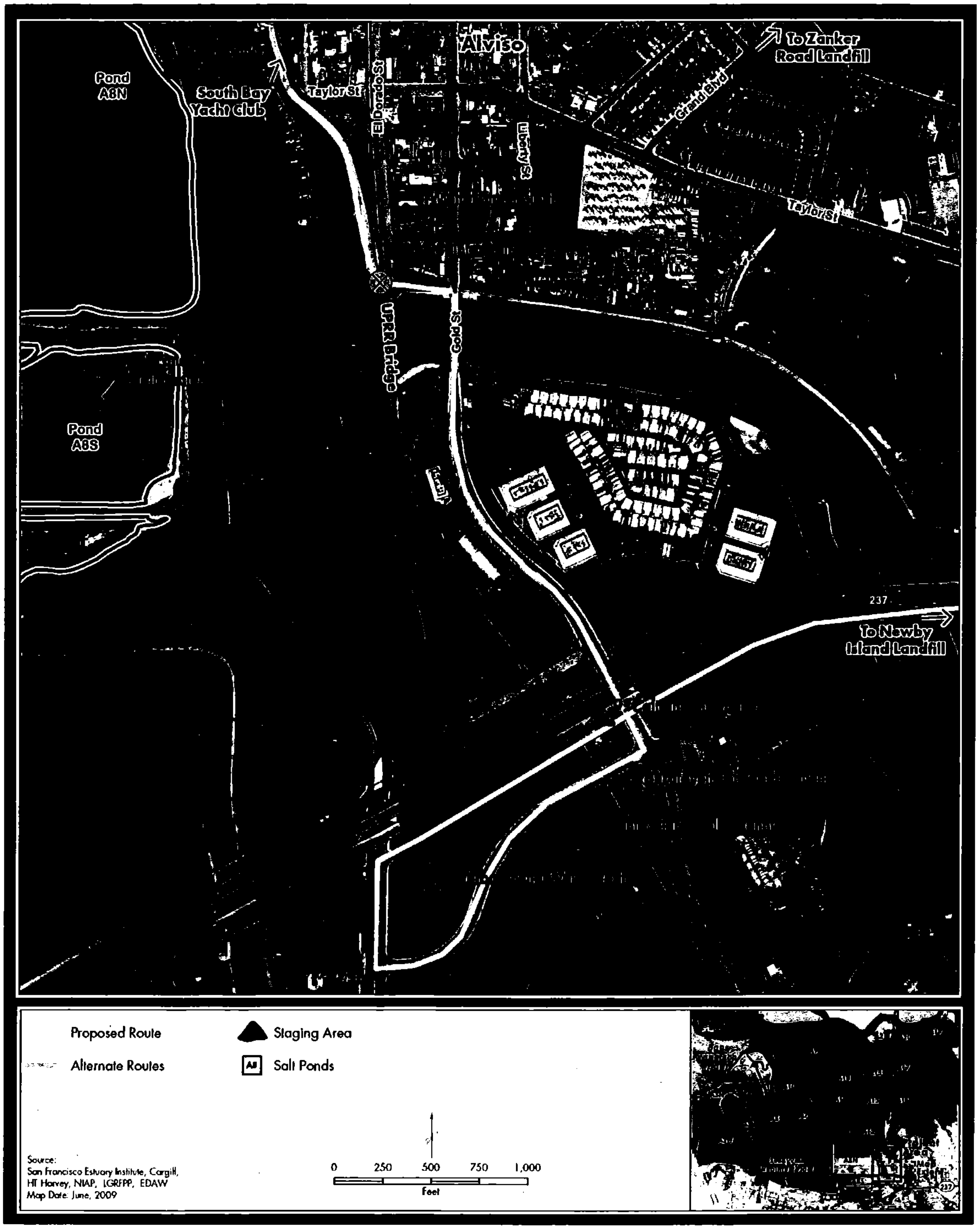
5.1.3.3 Staging/Stockpiling Areas

Figure 5-1 identifies potential sites for dewatering and stockpiling of plant material and sediments generated from clearing and dredging activities. If the actual rate of vegetation/root mass removal is as estimated earlier, approximately 1,600 c.y. of material would be removed every day for a period of 10 days. This would exceed the capacity of truck-hauling for disposal at the Zanker Landfill. Thus, some plant material would require temporary stockpiling prior to offsite disposal; about 1 acre of staging/stockpiling area would be required.

Based on estimated dredging rates described earlier, approximately 1,150 c.y. of dredged material would be generated per day. Assuming a 10-day dewatering time for such material, a minimum of 3.5 acres would be required to spread the material in a 2-foot layer for dewatering. A 4-acre site would be more beneficial, as it would allow off-loading and layering of the material and better accommodate truck traffic and the maneuvering of equipment to spread, till, place, and transfer material.

Because the dredged sediment would not be disposed of at the Newby Island Landfill at the same rate as it is dredged from the slough, some of the dredged sediment would have to be stockpiled before it could be adequately dewatered and hauled offsite.

EPA Method 9095 would be used to evaluate the dewatering limit for acceptance by the Newby Island Landfill. It is assumed that a 10-day dewatering period during the months of June through September would be adequate to meet landfill requirements. This dewatering time would be confirmed by testing of sediment cores. Analysis of sediment cores would also develop an environmental characterization profile for final disposal or reuse.



Source:
San Francisco Estuary Institute, Cargill,
HT Harvey, NIAP, LGRFPP, EDAW
Map Date: June, 2009

Figure 5-1. Proposed Staging/Stockpile Areas and Local Haul Routes

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Table 5-3 lists the potential staging sites identified in Figure 5-1, the current property owner (if known), each site's approximate acreage, and notations on possible benefits or complications.

Table 5-3. Potential Staging/Stockpiling Areas for Vegetation/Root Mass And Sediments Removed from Alviso Slough

Site Number(s)	Owner or street description	Acreage (est.)	Notes
1	SCVWD	15 acres	Site is to the west of proposed project work.
2	Pellegrini and SCVWD	0.57 acres	Site is conducive for eastern portion of site, but terrain may need some advance earthwork to create level surface.
3 and 4	3 – unknown site owner 4 – Sainte Claire Corp.	1.4 acres	Sites 3 and 4 are evaluated together, as potential closure of Moffat St. between the sites could make the location conducive for stockpiling sediment. Businesses and residents in the immediate vicinity of Gold St. might be affected by increased noise and potential odors.
5 (Alternate)	Pond A8S – State of California	> 2 acres	If material can be staged to this area for anticipated reuse within the site for the South Bay Salt Ponds Restoration project, this may be the most economical site. However, depending on the type of reuse planned, sediments from the project site would have to meet RWQCB criteria for wetland foundation and cover. Access within the interior of the site might be difficult; thus, placement should be made along perimeter provided this would be conducive for future reuse and distribution at site.
6	Yerba Buena Way – North	0.77 acres	Site is suitable for development; thus, cost and availability might limit the site as an option.
7	Santa Clara Golf and Tennis Club	2.2 acres	Site appears to be part of golf course and may be reserved for expansion of the course. Golf course may have need for sediment to improve upon facilities. Coordination with owner is warranted.
8	Lafayette St./Yerba Buena Way – SW Corner	0.2 acres	Site is small in size. Very flat and partially paved with drainage infrastructure; thus, it would be conducive for dewatering.
9	Caltrans, State of California	0.46 acres	Site has bridge shadow that might decrease dewatering process. Bridge columns might impede movement of material.

5.1.3.4 Construction Sequencing

Based upon discussions with dredging contractors, the maximum amount of dredged material that could be generated on a daily basis from work in Alviso Slough is 1,150 c.y. Newby Island Landfill limits deliveries of material to 80 trucks per day per project during the operating hours of 6 AM to 6 PM (Monday-Saturday). Another imposing limit is the number of trucks that a contractor can hire, which would be dictated by the current market demands. The number of trucks would be limited either by the hours of operation for the project site (local restrictions), Newby Island Landfill delivery limits, or the rate of sediment dredging. A truck could complete the acceptance of dredged sediment, placement of wet material at a staging location, acceptance of dry material, and disposal of dry material at the landfill within an hour of time. A 12 c.y. load is assumed for each truck; therefore, the landfill deliveries/day limit would be the limiting factor, allowing 80 truck trips a day.

Approximately 80 truck trips per day is achievable provided that a 10-hour work window and a maximum of 5 trucks are provided for this operation. The excess two hours beyond an assumed 8-hour work day is to account for potential traffic delays, breaks for drivers, and other contingencies for the trucking operations. Increases in the number of trucks would be based on the efficiency of the operations and establishing a reliable dewatering period for the dredged sediments. Based on an estimated 80 truck trips per day, a maximum estimate of 60,000 c.y. of dredged sediment, and a 10-day dewatering period for generated sediment, approximately 65 working days would be required to remove all of the dredged sediment from the Project Area to Newby Island Landfill.

If pre-construction sediment sampling determines that contaminant levels in the dredged sediments would exceed the maximum levels accepted by Newby Island Landfill, the dredged sediments may have to be disposed of at a special handling facility.

For vegetation/root mass removal, assuming an average of 0.5 acres of vegetation cleared per day, with an average yield of 3,200 c.y./acre of plant material, approximately 1,600 c.y. of plant material would be removed daily from the slough. The Zanker Landfill would accept this material for recycling, would not require any dewatering, and does not have a daily volumetric limit. Based on the assumption of a maximum of 80 truck trips per day (10 trucks w/ 12 c.y. capacity), the volume of plant material removed from the Project Area would be approximately 960 c.y. per day. Thus, it would take approximately 12-15 days to remove all of the plant material from the stockpiled areas. Plant material may decrease in volume as it is stockpiled, which may decrease the anticipated number of haul trips and the total number of working days for removal and disposal.

As presented in Table 5-2 and described in the previous paragraphs, with seasonal work restrictions in effect, it is expected that completion of all the work (no phased effort) for the staff-recommended alternative for the Alviso Slough Restoration Project would be completed within a 3- to 4-month period. This assumes that disposal of dredged sediments can be accomplished locally. If dredged material must be disposed of at a special handling facility, the hauling of stockpiled material could require 6 months to 1 year to complete.

5.1.4 Description of Haul Routes and Disposal Procedures

Figure 5-2 presents possible haul routes for transporting removed plant material and dredged sediments to local landfills. Vegetation material (dry or wet) would be transported to the Zanker Road Landfill facility, located two miles east of the Project site, for composting.

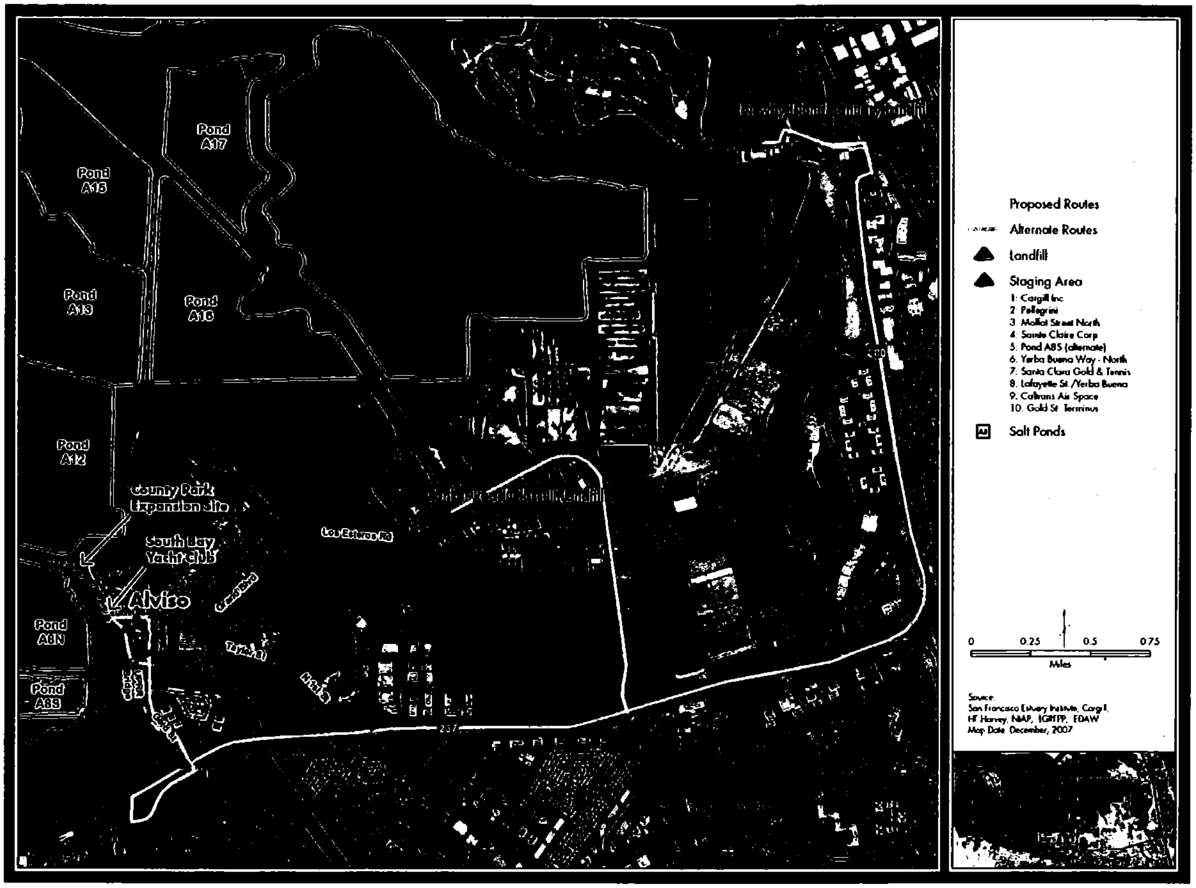

Figure 5-2. Proposed Haul Routes and Disposal Facilities

Haul trucks loaded at any one of the staging areas 1 through 5 (Figure 5-1) destined for the Zanker Road Landfill would travel by one of two routes: (1) enter Taylor Street eastbound at its intersection with Hope Street, proceed as Taylor becomes North 1st Street, turn left at Grand Boulevard, turn right as it becomes Los Esteros Road, and enter the landfill; or (2) from North 1st Street, access SR 237, take the Zanker Road exit and travel northbound as it becomes Los Esteros Road to the landfill. Loaded haul trucks leaving staging areas 1 through 5 destined for the Newby landfill would proceed as described above, but continue on North 1st Street to SR 237 eastbound, merge onto I-880 northbound, exit at Dixon Landing Road and travel westbound on Dixon Landing Road to the landfill.

Haul trucks loaded at staging areas 6 through 10 destined for the Zanker Road Landfill would access SR 237 eastbound, exit at Zanker Road, travel northbound as it becomes Los Esteros Road and enter the landfill. Trucks loaded at staging areas 6 through 10 and destined for the Newby landfill would enter SR 237 eastbound, merge onto I-880 northbound, exit at Dixon Landing Road and travel westbound on Dixon Landing Road to the landfill. The disposal costs for plant material at Zanker Road Landfill are estimated to be about $22/c.y.

The Newby Island Landfill requires a four-point composite sample be obtained for every 750 c.y. of sediment to be generated; however, the sample intensity could be reduced by gaining their input on a sampling and analysis plan of site sediments. Samples would have to be analyzed for metals and essentially compared to Title 22 requirements. Personnel of Newby Island Landfill would not discuss specific limitations for metals and preferred to examine initial results to determine if additional sampling would be needed or if prohibitions would be made upon specific sediment quantities (i.e. based upon locations and depth). Newby Island Landfill would also desire analysis of PCBs and pesticides if determined to be of a concern to site sediments; landfill restrictions of PCBs are limited to concentrations less than 50 parts per million (ppm). Materials delivered to the Newby Island Landfill cannot be saturated, but can be wet as long as materials can pass EPA Test Method 9095, commonly known as the paint filter test. The cost for disposal of dredged material at Newby Island Landfill would be $33/c.y.

As shown in both Figures 5-1 and 5-2, other potential material haul routes exist in the immediate vicinity of the Project site. These routes would avoid potential noise and air quality related inconveniences to neighborhood businesses and residents from truck trips to and from the Project site and the various proposed staging areas. However, because these haul routes would require access to private rights-of-way, and it is uncertain whether access to these routes could be secured, these routes would be considered less feasible than the public access haul routes described above.

Disposal of Sunken Boat Material and Other Debris
Sunken boats or other debris that are generated by vegetation/root mass removal or sediment dredging in the Project Area would be transported to the Zanker Road Landfill facility. The disposal costs for wood debris at this landfill is currently $22/c.y., the same as disposal for plant material.

5.2 Land Ownership and Right of Way Requirements

Ownership maps along the slough in the vicinity of the Project Area are included in Appendix F. The staging areas identified in Figures 5-1 and 5-2 would require acquisition or access agreements from current landowners as listed in Table 5-3. For the optional disposal haul routes, also shown in Figures 5-1 and 5-2, an agreement would be required with the UPRR for establishing a temporary railroad crossing to transport material by vehicle for the eastern portion of the project site. An access agreement would also be required to utilize the State of California sites; however, such an agreement may already be in place to allow SCVWD maintenance personnel access to levees along the slough. Use of private parcels would require agreements with Legacy Partners Commercial, Inc. and/or Gold Team, LLC.

Chapter 6
Operation and Maintenance Program

This chapter outlines the maintenance standards, methods, estimated maintenance intervals, and monitoring for the recommended project alternative. The primary component of the program would be periodic sediment removal to sustain the open water width and depths of Alviso Slough within this footprint. This component is discussed for the project alone, and with the addition of the SBSP Phase 1 Action at Pond A8.

As discussed in the Conceptual Model Memorandum (PWA 2007) (Appendix D), the recommended project alternative work would be performed in a highly depositional environment. Periodic sediment removal would be required to maintain the deepened portions of Alviso Slough at design channel depths within an acceptable maintenance limit.

Maintenance activities would be scheduled to minimize adverse impacts to fish and wildlife resources and habitat, as required by permit. Permit conditions for the project have not yet been identified. Permits for the Lower Guadalupe River Project (LGRP) identify periods of concern as March through June for nesting birds and October through March for fish passage (SCVWD 2001). Permit discussions in progress for the SBSP Restoration Project identify periods of concern as February through August for nesting birds (including the California clapper rail) and November through April for fish passage.

6.1 Monitoring

Annual visual inspection would be used to assess sediment deposition and any re-emergent vegetation re-growth within the 3.7-acre Project Area. Monitoring would be performed either by hydrographic surveys or visual observations at low tide, in combination with discussions with local boaters. If the SBSP Phase 1 Action at Pond A8 is implemented and successful, natural scouring of deposited sediments could occur due to the increased tidal prism in this reach of Alviso Slough. The extent of long-term scour would be assessed during the annual surveys.

6.2 Maintenance Methods

Sediment removal (dredging) would be necessary to maintain conditions similar to the design condition at the end of the initial project work. Prior to each round of maintenance dredging, biological surveys would be performed to confirm the presence or absence of sensitive species and prepare a maintenance plan to avoid impacts to the maximum extent practicable. Sediment sampling would also be performed to characterize the quality of dredged material, which would determine disposal options. Dredging would be accomplished using an Aquamog with a clambucket attachment or other appropriate equipment. Depending on the sediment disposal option used, sediments may require dewatering prior to disposal and would be delivered to a staging area for this process.

When sediment deposition or vegetation conditions exceed the acceptable maintenance limit, maintenance activity would restore the as-constructed design conditions. Anticipated maintenance intervals are based on engineering calculations and judgment, and are subject to revision based on the monitoring program results.

Since the entire 3.7 acres of the staff-recommended project footprint would be dredged to a depth of 8 feet, it is anticipated that there would be minimal re-emergence of vegetation within this footprint. As described in the previous paragraphs, newly deposited sediments in the project footprint would be monitored annually and removed periodically to maintain the as-built project condition. Thus, the probability of vegetation re-establishment in this area is minimal, though some vegetation maintenance may occasionally be necessary along the edge of the project footprint.

6.3 Estimated Maintenance Intervals

Mean tide level (MTL) is proposed as a reasonable maintenance limit for sediment removal because it minimizes the required frequency of dredging within the constraints of maintaining the channel invert below elevations that would encourage vegetation colonization (approximately MTL + 1.0 ft. (Williams, Orr et al. 2002). Using a mean tide level maintenance limit also allows a moderate amount of draft (approximately 4 feet at high tide) for boat navigation.

The difference between the design dredge depth (-0.7 ft NAVD88) and the maintenance limit of mean tide level (2.9 ft NAVD88) is 3.6 ft. At typical sedimentation rates of one to two feet per year, dredging would be required approximately every 2-4 years on average until the SBSP Phase 1 Action at Pond A8 is fully operational and sustains navigable depths in this reach of the slough as a result of the increased tidal prism. The estimated sedimentation rate of one to two feet per year is based on observed sedimentation rates in the former Alviso County Marina during the 1980s (Ruth & Going, 1980). Actual sedimentation rates in the slough channel between Gold Street and the Alviso County Marina may differ due to differences in sediment supply and sediment dynamics between the slough and the former marina. Actual dredging frequency would depend on the monitoring results and could be more or less frequent than the estimates provided here. For costing purposes, two maintenance dredging actions are assumed over the first 10-year post-project timeframe. For cost-estimating purposes, each of these actions is assumed to require the same effort and generate the same volume of dredged material as the initial project effort (Chapter 5).

6.4 Alviso Slough Levees and Pond A8 Overflow Weir Maintenance

The District maintains an existing flood protection levee along the east side of Alviso Slough within the boundaries of the Project Area. Sediment and vegetation/root mass removal associated with the recommended alternative would increase the open water area over which wind-waves would be generated, and decrease the area of vegetated marsh over which wave energy would be absorbed before reaching the flood protection levee. The recommended alternative may increase the potential for erosion of the flood protection levee.

The District currently conducts regular inspections and maintenance of its flood protection levees and the Pond A8 overflow weir as part of the Lower Guadalupe River Project (LGRP). Long-term inspections and maintenance for the Alviso Slough Restoration Project would be integrated with the ongoing LGRP efforts. Regular inspection of the flood protection levee and of the overflow weir would be conducted to identify erosion and assess any threats to levee integrity. Inspection of the flood protection levee would be monthly initially, then annually and after major rainfall or tidal storm events. Inspections of the Pond A8 overflow weir would be conducted annually and following major storm events that have the potential to overtop the weir. It should be noted that the post-project elevation of the Pond A8 overflow weir would be below the 100-yr extreme water level for Alviso Slough (approximately 11.0 ft NAVD88), and within 0.2 feet of the 10-yr extreme water level (10.7 feet NAVD88) (PWA 2006).

The existing flood protection levee would be repaired and maintained as needed. Consistent with the maintenance program for the LGRP, the District would repair or maintain its levees to preserve current levels of flood protection. Repairs may take several forms such as grading or armoring. Similarly, the Pond A8 overflow weir would be repaired and maintained as needed.

The managed pond levees to the west of the Project area and downstream were originally constructed for commercial salt production. Though they are not maintained for flood protection, they provide some level of flood protection for the managed ponds and, indirectly, for the Town of Alviso. The ponds and levees are owned and maintained by the USFWS, as part of the Don Edwards San Francisco Bay National Wildlife Refuge.

As per the above discussion of the potential for levee erosion due to open water wind-wave forces, the recommended alternative work may increase the potential for erosion of the USFWS managed pond levee adjacent to the west of the Project Area from the end of the Pond A8 weir northward to opposite the Alviso County Marina. The District and USFWS regularly exchange information on levee erosion as noted during their ongoing inspections, and erosion repair on the Pond A8 levee between the Pond A8 weir and the Alviso County Marina, as necessitated by post-project conditions and effects, will be jointly coordinated between the two agencies.

6.5 Influence of Pond A8 Tidal Restoration

The Phase 1 Action of the SBSP Restoration Project at Pond A8 (Pond A8 Notch) is projected to increase tidal flows through Alviso Slough in the Project Area, and, over time, may reduce the level and frequency of dredging required to maintain the open water and mudflat conditions resulting from the implementation of the recommended alternative for the Alviso Slough Restoration Project. The operation of the Pond A8 Notch would increase tidal currents and may also modify sediment dynamics within the slough (i.e. diminish the dominance of flood-tide currents, as indicated by numerical modeling performed for the SBSP Restoration Project), and reduce the net transport of estuarine sediments upstream.

Current SBSP plans call for partial tidal restoration initially, using the 40-foot wide notch connecting Pond A8 to Alviso Slough. Partial tidal restoration of Pond A8 would sustain a wider channel (estimated at 50 to 90 feet) just downstream of the connection between Alviso Slough and Pond A8. If the recommended alternative for the Alviso Slough Restoration Project is implemented, the resulting open water width in the vicinity of the South Bay Yacht Club would be approximately 100 feet. The Pond A8 Phase 1 Action would likely sustain at least a portion of this widened channel, reducing the required volume of dredge material removed in a given dredge cycle and possibly reducing the required frequency of dredging.

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Chapter 7
Costs and Financing of Staff-Recommended Alternative

7.1 Staff-Recommended Alternative - Capital and O&M Costs

Table 7-1 presents the current estimated cost for the Staff-Recommended Alternative (Alternative 3), for two scenarios:

1) The staff-recommended alternative is completed in one action (the full clearance and dredging over 3.7 acres

2) The staff-recommended alternative is completed in phases, with the initial phase clearing 1 acre in the Project area.

It is estimated that design phase costs to complete a construction bid package (plans and specifications) and successfully negotiate permits from the regulatory agencies would cost $500,000 for either scenario.

The initial capital outlay for removing vegetation and root mass and dredging to a depth of 8 feet over a 3.7-acre area between the Gold Street Bridge and the Alviso County Marina would range between $6.2M and $12.0M. The most expensive element of the work is the hauling and disposal of the dredged sediments ($2.4 M - $7.2M, depending on where the dredged sediment can be disposed).

The initial capital outlay for clearing and dredging a 1-acre area would range from $2.4M to $4M, with haul and disposal of the dredged sediments the most costly work element. Additional vegetation removal and dredging would be undertaking over a multi-year period, but would be performed to align with the gradual widening and deepening of the slough channel from Pond A7 Notch operations.

Projected Operations and Maintenance (O&M) costs over the first 10-year period after project implementation are also provided in Table 7-1. For Scenario 1, monitoring of the wetland mitigation site(s) would be required for about 5 years after the mitigation would be completed, and would cost approximately $370,000 over that period of time. As described in Chapter 6, it is estimated that within the first 10 years of project implementation, newly-deposited sediments in the reach of Alviso Slough would have to be removed 2 or 3 times to sustain the open channel width and depth of the slough within the proposed project footprint. On an annual basis, approximately $1.2M - $2.9M may have to be set aside to finance the periodic maintenance work, depending on the sediment disposal location.

Table 7-1. Estimated Capital and 10-Year O&M Costs for the Staff-Recommended Alternative 3

Work Element	**Full Implementation (3.7 acres)**	**Phased (1 acre initial) Implementation**
Vegetation /Root Mass Removal and/or Dredging	3.7 ac to 8-ft depth	1 ac to 8-ft depth
Vegetation Disposal, c.y.	12,000	3,200
Sediment Disposal (dry), c.y.	60,000	16,000
Design and Permit Negotiations	$500,000	$500,000
Pre-Construction surveys and sampling	$150,000 - $200,000	$100,000
Clearing/Grading of Staging Areas, as needed ($10,000/acre)	$50,000	$20,000
Dredging + Stockpiling ($120K per acre)	$444,000	$120,000
Trucking Vegetation to Local Disposal Site (10 trucks daily @ $7500/day)	14 days= $105,000	$30,000
Trucking Sediments to Local Disposal Site (10 trucks daily @ $7500/day) vs. Trucking to Special Disposal Site (20 trucks daily @ $15,000/day)	65 days = $0.5M to $1.0M[1]	18 days =$0.14M to $0.27M[1]
Sediment Disposal Fee ($33/c.y - $104/c.y.)	$1.98M - $6.24M	$0.54M - $1.66M
Vegetation Disposal Fee ($22/c.y.)	$260,000	$70,000
Debris/Abandoned Vessels Removal (one time cost)	$250,000	$250,000
Modification of Pond A8 Weir (one time cost)	$150,000	$50,000
Mitigation Costs (2:1 replacement)	$740,000	$200,000
Biological Monitoring during Construction	$50,000	$25,000
Subtotal of construction costs	**$5.2M - $10M**	**$2M - $3.3M**
20% Contingency	$1M - $2.0M	$0.4M – 0.7M
Total Est. Capital Cost (Design + Const) (2008 $)	**$6.2M - $12.0M**	**$2.4 - $4M**
Ongoing monitoring of mitigation sites for 5 years ($10K/ acre/ year)	$370,000	$100,000
Sediment Removal Maintenance (3 rounds over 10 Years)	$9M - $24M	To be determined based on Pond A8 Notch operations
Subtotal	**$9.4M - $24.0M**	
20% Contingency	$1.9M - $5.0M	
Total Est. O&M Cost over 10 Years (2008 $)	**$11.3M - $29.0M**	

[1] If dredged sediment must be disposed of at a special facility, truck haul roundtrips would increase from one hour to two hours.

For Scenario 1, long-term O&M costs may decrease due to two factors:

1) If the Phase 1 Action at Pond A8 is successful, the increased tidal prism generated by the notched connection between Alviso Slough and Pond A8 may naturally scour the Alviso Slough channel within the Project Area and reduce the anticipated post-project sedimentation rates.

2) Although sediment quality data recently collected in the vicinity of the Project Area indicate dredged sediments could not be re-used for local pond restoration efforts, sediment quality data would be collected prior to any future maintenance activity. Sediments that accrete in the slough after the initial project work may contain less mercury and other legacy contaminants, and may qualify for local re-use options that would eliminate truck hauling and landfill disposal.

For Scenario 2, long-term monitoring costs for the mitigation site would be approximately $100,000 over a 5-year period. Other O&M costs would be determined based on the success of Pond A8 Notch operations in continuing to scour and maintain the cleared 1-acre area. In the longer term, as the Pond A8 Notch operations are better understood, additional clearing and dredging within the proposed 3.7-acre Project area would focus on alignment with the natural scouring process so as to minimize the District's long-term maintenance costs.

7.2 Project Financing

The proposed project would be financed by the Watershed and Stream Stewardship Fund.

If the full 3.7 acres are cleared and dredged, between $1.2M - $2.9M may have to be set aside annually from property tax revenues to fund removal of periodic dredging of the slough channel to maintain post-project conditions. After project implementation, staff would adjust budget requests for future maintenance based on the likely disposal facility for sediments generated from maintenance dredging. As stated earlier, long-term maintenance costs may be reduced if the Pond A8 Phase 1 Action is successful in naturally scouring the Alviso Slough channel in the Project area.

If the project effort is phased over a multi-year period to align with the operations of the Pond A8 Notch, later capital and O&M expenditures may be lower if the notch operations sustain a wider and deeper slough channel over time.

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Appendix A
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Chapter 7

None

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Appendix B

Alviso Lower Guadalupe Collaborative Document

ALVISO AND LOWER GUADALUPE COLLABORATIVE

Approved by:

Stanley L. Williams
Chief Executive Officer
Santa Clara Valley Water District

Effective Date: December 6, 2004

Approved by:

George Trevino, Chair
Alviso Water Task Force
P.O. Box 761
Alviso, CA 95002

Date: 12-6-2004

Collaborative Prepared and Facilitated by:

Mary Ann Ruiz

Santa Clara Valley
Water District

Alviso Water Task Force

ALVISO AND LOWER GUADALUPE COLLABORATIVE

This is a framework to define the collaborative process between the Alviso Water Task Force and the Santa Clara Valley Water District (District). This collaborative is based upon a mutual wish to work together, to build trust, and achieve successful implementation of Alviso projects.

COLLABORATIVE VISION

Create a model in combining effective flood protection, habitat enhancement and restoration, and recreation in an urban area.

1. Goals of Alviso Water Task Force

The primary goal of the Alviso Water Task Force is to work collaboratively with individuals and agencies to develop projects that combine effective flood protection, wildlife habitat enhancement and restoration, and recreation and quality of life improvements in and around the community of Alviso.

2. Santa Clara Valley Water District

The mission of the District is a healthy, safe and enhanced quality of living in Santa Clara County through watershed stewardship and comprehensive management of water resources in a practical, cost-effective and environmentally sensitive manner.

3. District Interests in the Alviso Community

a) To design and construct projects in the Alviso community that are consistent with District's mission, supported by the community and approved by regulatory agencies.

b) Remove 7 acres of vegetation and root mass to a depth of 4 feet between the Gold Street Bridge and County Marina.

c) Restore the slough's open water channel width to prior to 1983 conditions. Photos of the slough from 1982 are shown in Attachments 2 and 3.

d) Improve navigation so the community can expand on boating and other recreational opportunities.

e) Restore historic public access and aesthetics for the Alviso community.

f) Maintain 1 percent flood protection in Alviso Slough.

g) Reduce mosquito nuisance.

h) Expand open water habitat and inundated mudflat habitat of the slough.

i) Promote the integration with the Salt Pond Restoration Program to bring saltwater connections to the Lower Guadalupe River.

j) Establish a muted tidal connection between Pond A-8 and the Alviso Slough for the purpose of increasing the tidal prism and water velocities in the slough through the South Bay Salt Pond Restoration Project. This effort should be considered as part of the South Bay Salt Pond Restoration Project potential Phase I project.

k) Interim management and long-term restoration that provides for maintenance of flood protection levees.

l) Reduce bank erosion and sedimentation-related impacts along the Lower Guadalupe River.

m) Identify potential project impacts on Alviso and bayland areas and mitigate significant impacts.

n) Provide tidal flood protection for the Alviso community.

4. Alviso Water Task Force Interests

a) Provide Restoration of the Guadalupe River to conditions prior to 1983 and provide Flood Control for the community in a manner that will incorporate the removal of the nonnative vegetation, create a tidal connection, and increase the salt water flow in the lower Guadalupe River.

b) Foster increased natural wildlife, wildlife habitat and fisheries in the region by improving the environmental quality of the river and restoring the salt water flow through Pond A8 and the Lower Guadalupe River.

c) Promote economic revitalization by restoring the recreational boating and waterway access to Santa Clara County by way of the Alviso Slough and the Lower Guadalupe River.

d) Improve the channel conveyance capacity immediately downstream of the Gold Street Bridge to convey, at a minimum, the in-channel flow volume anticipated to flow under the bridge during a 1 percent flood.

e) Accomplish the Alviso Slough Restoration Project goals by utilizing a design that recognizes and integrates with current and future projects.

f) Quickly establish a mutual tidal connection between Pond A8 and the Alviso slough for the purpose of increasing salinity levels, tidal flow velocity, and dimensions in the upper slough.

g) Work with the South Bay Salt Pond Restoration effort to provide tidal connection between Pond A8 and the Guadalupe River during Phase I of the program.

h) Strongly encourage the District to utilize Clean, Safe Creeks funds for the purpose of increasing salinity levels, tidal flow velocity, and dimensions between Pond A8 and the Alviso Slough.

i) Increase flood control by improving the management of the pump operations along the Guadalupe River.

j) Create an aesthetically pleasing project that we can all be proud of.

k) Provide trail extensions, trail improvements, and walkways to enjoy the nature.

l) Restore the salt water flow in the Lower Guadalupe River.

5. **Shared (Common) Collaborative Vision**

a) Remove 7 acres of vegetation and root mass to a depth of 4 feet between the Gold Street Bridge and County Marina. (Attachment 1)

b) Restore the slough's open water channel width to prior to 1983 conditions. (Photos of the slough from 1982 are shown in Attachments 2 and 3.)

c) Improve navigable access so the community can expand on boating and other recreational opportunities.

d) Restore historic public access and aesthetics for the Alviso community.

e) Maintain 1 percent flood protection in Alviso Slough.

f) Reduce mosquito nuisance.

g) Expand open water habitat and inundated mudflat habitat of the slough.

h) Promote integration with the Salt Pond Restoration Program to bring saltwater connections to the Lower Guadalupe River.

i) Foster increased natural wildlife, wildlife habitat and fisheries in the region by improving the environmental quality of the river.

j) Enhance recreational opportunities and waterway access to Santa Clara County by way of the Alviso Slough and the Lower Guadalupe River.

k) Improve the channel conveyance system capacity immediately downstream of the Gold Street Bridge to convey, at a minimum, the in-channel volume of water anticipated to flow under the bridge during a 1 percent flood.

l) Develop a multi-objective project that utilizes a design that recognizes and integrates with current and future projects.

m) Encourage the muted tidal connection between Pond A-8 and the Alviso Slough for the purpose of increasing the tidal prism and water velocities in the slough as a potential Phase I of the South Bay Salt Pond Restoration Project.

n) Ensure pump management does not compromise levee integrity.

o) Create an aesthetically pleasing project that we can all be proud of.

p) Provides trail extensions, trail improvements, and walkways that allow community members and visitors to enjoy the nature.

q) Provide tidal flood protection for the Alviso community.

ALVISO AND LOWER GUADALUPE COLLABORATIVE PRINCIPLES

These Collaborative Principles dated December 6, 2004, are accepted by and between members of the Alviso Water Task Force and the District.

A. The Alviso and Lower Guadalupe Collaborative (Collaborative) was formed to collectively work toward effective flood protection, habitat enhancement and restoration, and recreation in the Alviso area. The Collaborative participants include District staff and the Alviso Water Task Force, which consists of Alviso residents, interested parties, and legislators.

B. The members of the Collaborative understand that there are a multitude of projects such as the Lower Guadalupe Flood Protection Project and the Alviso Slough Restoration Project. These Collaborative Principles describe how the Collaborative will work together to successfully achieve Alviso project goals.

C. The Collaborative understands that it is necessary to work together to ensure that identified goals will be completed within the estimated budget and schedule.

D. This document is not a legally binding document but is signed in good faith.

In view of the above, and assuming that the District Board of Directors will continue to provide funding and support for Alviso projects, the parties agree as follows:

SECTION 1: ALVISO AND LOWER GUADALUPE COLLABORATIVE

1. Collaborative Members' Responsibilities

a. Collaborative members shall actively support the collaborative vision defined in this Alviso and Lower Guadalupe Collaborative Document.

b. Collaborative members shall keep their member organizations apprised on the progress and issues of the Collaborative.

c. Any member wishing to terminate their participation in the Collaborative shall provide notice to the Collaborative through the Alviso Water Task Force. Written notification is preferred.

d. Collaborative members are responsible for maintaining knowledge of the progress and issues identified and providing timely comments.

e. Collaborative members are responsible for raising issues of concern and helping to collaboratively resolve the issue.

f. Any member of the Collaborative can request third party facilitation.

2. Meetings

a. The Collaborative will meet monthly, on the second Tuesday of each month, unless a change in the meeting date is mutually agreed upon. All Collaborative meetings are open to the public.

b. The monthly meetings will continue to be attended by senior level District management.

c. Collaborative members shall actively participate in the Collaborative meetings by articulating their concerns or support of issues.

d. The District will provide a facilitator that will summarize the meeting, record and finalize the meeting notes and ensure that it is posted on the Alviso and Lower Guadalupe web site for review and concurrence at the next meeting.

e. The facilitator will also be responsible for assisting with the drafting of the monthly meeting agenda which will be mutually agreed upon by members of the Collaborative.

3. Incorporation of Additional Participants

a. Additional participants may join the Collaborative effort, as agreed upon by the members of the Collaborative.

b. New participants are expected to educate themselves to support the goals, objectives and principles of the Collaborative.

4. Communication and Outreach with the Community

The Collaborative will assist in the development of the outreach plans related to Alviso projects for the community.

5. Project Planning and Design

The Collaborative shall provide input to the design and development of Alviso project plans.

6. Project Construction

Collaborative members acknowledge that there will be disruption and inconveniences during the construction of Alviso projects that may include, but is not limited to: noise; traffic congestion; dust; and temporary aesthetic impacts.

7. Document Availability

The Collaborative will endeavor to make documents available on the Alviso and Lower Guadalupe Collaborative website or District website upon request.

8. Issue Resolution

a. Issues between the Collaborative will be arbitrated between the participating parties with the assistance of a facilitator who is independent but familiar with the program.

b. The Chair of the Alviso Water Task Force will act as the designated contact and spokesperson for the Alviso Water Task Force. If there are concerns or questions that arise, the Chair of the Alviso Water Task Force will raise them to the designated District senior manager (Collaborative Manager). The Collaborative Manager will respond to issues of concern within two business days.

c. Issues not resolved within the Collaborative may be escalated to the Board of Directors after notification to all involved parties.

SECTION 2: ALVISO WATER TASK FORCE

1. Alviso Water Task Force Members Responsibilities

a. The Chair of the Alviso Water Task Force will act as the designated contact and spokesperson for the Alviso Water Task Force.

b. The Alviso Water Task Force will continue to maintain a membership to participate in the Collaborative and to support the goals of the Collaborative.

c. The Alviso Water Task Force will maintain a listing of Alviso Water Task Force members and provide a copy to the District upon request.

2. Meetings

The Alviso Water Task Force will hold internal community meetings monthly or as often as necessary. The Task Force will be responsible for the planning of their internal meetings. The monthly Task Force meetings will be to review the proposed agenda of the Collaborative and discuss issues.

3. Outreach to the Community

a. The Chair of the Alviso Water Task Force will keep the District abreast of issues and concerns in the Alviso community.

b. The Alviso Water Task Force will continue to reach out to the community to encourage community members' participation in the Collaborative and other events held by the Collaborative.

c. The Alviso Water Task Force will solicit and compile comments, concerns, and issues related to the development of the Projects from active and non-active members.

4. Project Planning and Design

a. Provide timely response and assist with solutions to issues during planning, design, construction, and maintenance.

b. The Alviso Water Task Force members will provide relevant records, data, information and documents requested by the District for the planning, design, construction, operation, and maintenance of projects.

5. Project Construction

The Alviso Water Task Force will provide a single point of contact to inform its members of construction plans and progress.

SECTION 3: SANTA CLARA VALLEY WATER DISTRICT

1. District Responsibilities

a. The District will aggressively seek funding to complete projects.

b. A senior manager will be designated the Collaborative Manager to manage the collaborative process and resolve issues of concern.

2. Meetings

a. The District will provide meeting notification flyers to the Collaborative, sent by mail approximately two weeks prior to the meeting.

b. The District will arrange for the meeting location of the Collaborative.

c. The District will prepare initial draft meeting notes for Collaborative meetings.

3. Communication and Outreach

a. The Collaborative Manager will keep the Collaborative abreast of items pertaining to Alviso that will be submitted to the District Board of Directors for discussion or action.

b. The District shall provide a two week minimum/three week maximum prior notification of planned construction activities, to the Alviso Water Task Force and community, with an exception to be made for emergency situations where there will be a two business day notification.

c. The District will provide, by mail, project notification flyers to the Alviso community prior to construction.

d. The District will ensure that the Alviso Water Task Force Chair and facilitator are informed of actions and activities that may affect the community and/or the Collaborative.

e. The District will maintain the Alviso and Lower Guadalupe Collaborative web site currently located at http://www.valleywater.org/Water/Watersheds_-_streams_and_floods/Watershed_info_&_projects/Guadalupe/_Alviso_enhancement/index.shtm.

4. Project Planning and Design

a. The District shall take the lead on conducting the planning and design of the Projects.

b. The District shall provide the overall project management of each Project through the planning, design and construction and monitoring phases of each Project.

c. District will keep the Collaborative members informed of the progress of all projects and provide all reasonable information requested by Collaborative members.

5. Project Construction

a. The District will minimize the disruption to community and property owners as addressed in the California Environmental Quality Act (CEQA) documents.

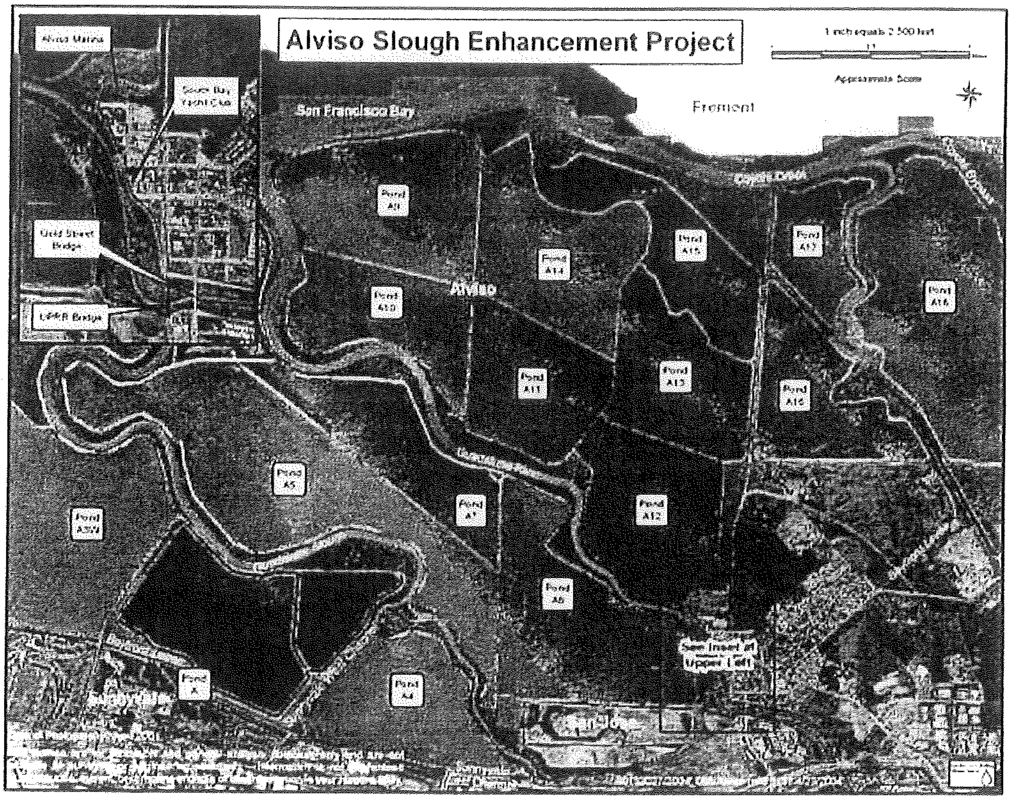
b. The District will provide the overall Alviso project management throughout the planning, design and construction phases.

6. Records Availability

The District shall provide Alviso project records for viewing at the District.

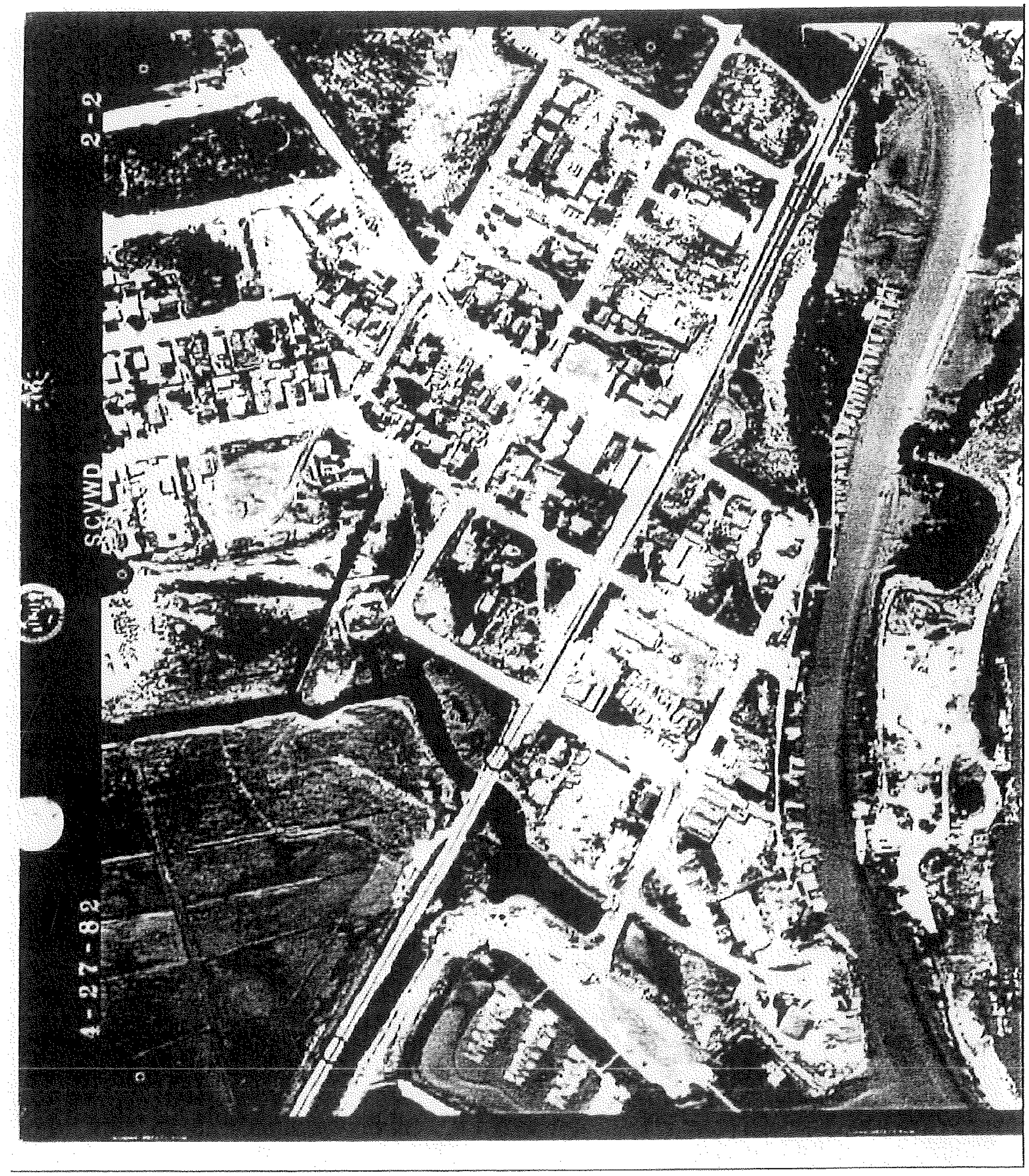
APPENDIX 1

Project Location Map



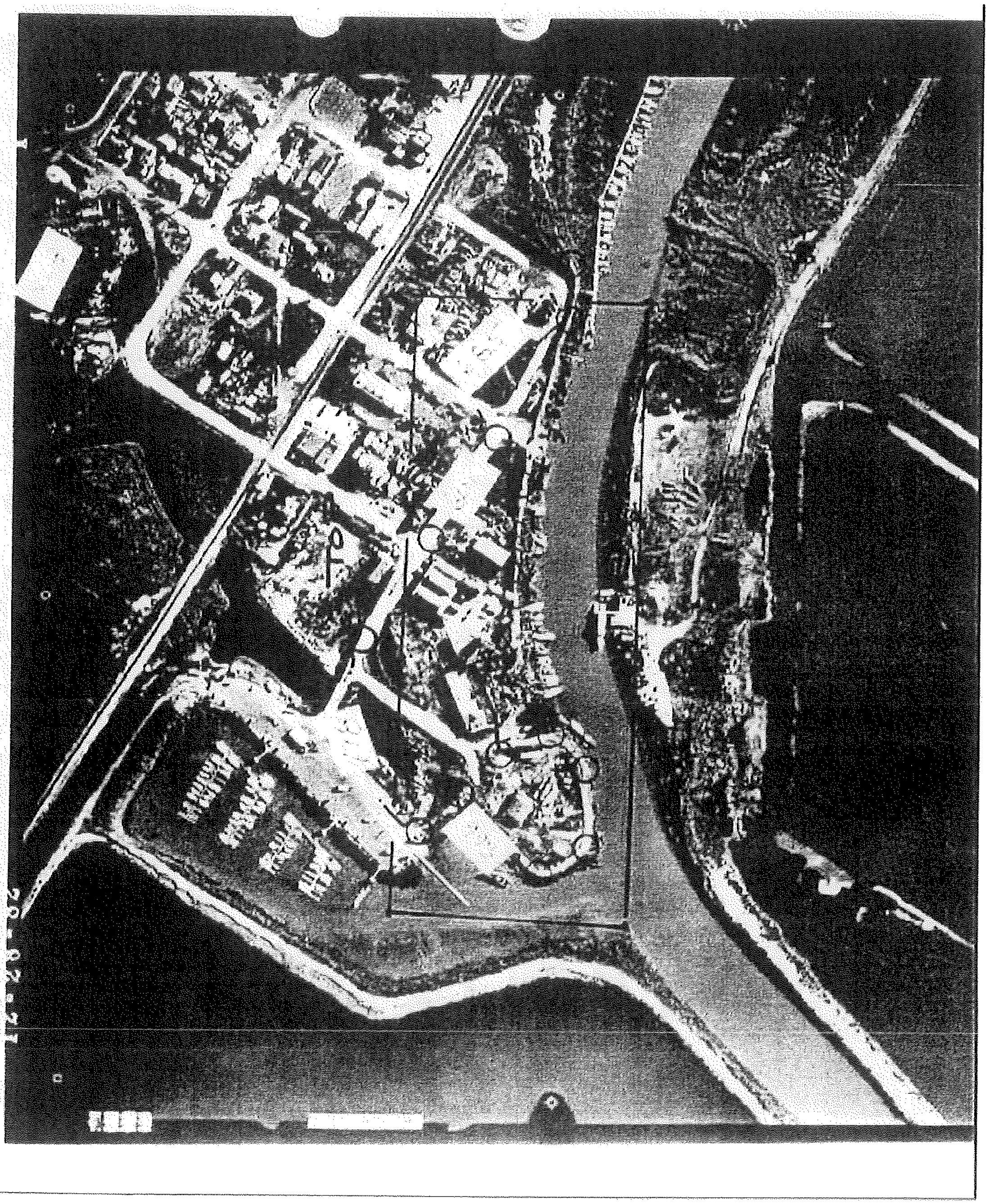
APPENDIX 2

Alviso Slough Photo 1 (1982)



APPENDIX 3

Alviso Slough Photo 2 (1982)



APPENDIX 4

Key Participants

There are numerous interested parties and stakeholders who will work together to achieve the Collaborative vision, projects, and activities. The following is a partial list of those "Key Participants."

Key Participants	Role	Responsible Contact
Alviso Water Task Force	Concerned residents and other interested members.	George Trevino, Chair, Alviso Water Task Force
Santa Clara Valley Water District	Lead Agency	Stanley L. Williams, Chief Executive Officer, Santa Clara Valley Water District
BCDC	Certain projects require a permit from this agency before construction.	Will Travis, Executive Director
U.S. Fish & Wildlife Service	Regulatory Agency- The U.S. Fish and Wildlife Service's mission is, working with others, to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. This agency is the property owner of Pond A8 and Pond A12; a biological opinion must be obtained before construction.	Clyde Morris, Manager
California State Lands Commission	The dynamic nature of the interface of waterways (ocean, rivers, bays, lakes, etc.) with adjoining lands makes the determination of the common boundaries between public trust lands and private property a complex issue. Certain projects require a permit from this agency before construction.	
City of San Jose	Ensure the project implements the Alviso Master Plan	Office of Emergency Services

Regional Water Quality Control Board	The mission of the Board is to preserve, enhance and restore the quality of California's water resources, and ensure their proper allocation and efficient use for the benefit of present and future generations. Certain projects require a permit from this agency before construction.	Bruce Wolfe, Executive Officer, Region 2
California Department of Fish and Game	The Mission of the Department of Fish and Game is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. Certain projects require a Streambed Alteration Agreement from this agency before construction.	Regional Manager Rob Floerke
U.S. Army Corps of Engineers	This agency has jurisdiction over U.S. Wetlands and navigable waters of the U.S. under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Projects that impact these resources will require a permit from this agency. In addition, projects must coordinate with the South San Francisco Bay Shoreline Study, the ongoing Corps' project to evaluate tidal and fluvial flood protection, environmental protection and restoration, and related purposes in the South Bay.	
NOAA Fisheries (National Marine Fisheries Service) Biological Opinion	Certain projects require a biological opinion from this agency before construction.	
Participants: To keep informed		

Senator Figueroa staff	State Senator who represents the proposed project area. Enlist support of the various state agencies for this project.	
Assemblymember Lieber Staff	Assembly member who represents the proposed project area. Enlist support of the various state agencies for this project.	
Participants: Vegetation Removal		
Agencies including:	Regulatory Agencies	
BCDC		Will Travis
Corp of Engineers		Colonel Feir
US Fish & Wildlife Service Game		Clyde Morris
California Department of Fish & Game		Steve Ritchie
California State Land Commission		
Regional Water Quality Control Board		Bruce Wolfe
Coastal Conservancy		Steve Ritchie
Eric Carruthers and additional BCDC commissioners (see list)	Commissioner of BCDC: Alternate representative to Liz Kniss for Santa Clara County.	
Citizen Advisory Committee to the BCDC (Russ Robinson)	Makes recommendations to BCDC staff.	

APPENDIX 5

Definitions

1. ***Alviso Water Task Force***—a group of concerned residents of Alviso and other interested parties, formed to address issues of flooding, restoration, and environmental protection.
2. ***Collaborative***—the combined group that includes Santa Clara Valley Water District staff and Alviso Water Task Force members.
3. ***Collaborative Member***—a participant on the Collaborative and may be a signatory to the Collaborative Principles.
4. ***District***—Santa Clara Valley Water District.
5. ***Facilitator***—a mutually agreed upon third party individual provided by the Santa Clara Valley Water District.
6. ***Outreach Plan***—a plan that describes how the project team will communicate with the community during the development of the project.
7. ***Project Plan***—document that identifies the project's goals, objectives, constraints, preliminary budget and preliminary schedule.

Appendix C

Alviso Slough Sedimentation and Hydraulic Geometry Analysis Technical Memorandum

PWA
PHILIP WILLIAMS & ASSOCIATES, LTD
ENVIRONMENTAL HYDROLOGY
550 Kearny Street, Suite 900
San Francisco, California 94108-2404
TEL 415.262.2300 FAX 415.262.2303
www.pwa-ltd.com

MEMORANDUM

Date:	October 16, 2007 – *revised January 14, 2008*
To:	Suet Chau
Organization:	EDAW
From:	Nick Garrity, Justin Vandever, and Michelle Orr
PWA Project #:	1840
PWA Project Name:	Alviso Slough Restoration Project
Subject:	Task 7.2: Sedimentation and Hydraulic Geometry Analysis
Copy(ies) To:	Bal Ganjoo and Mike Coleman, SCVWD

1 INTRODUCTION

PWA performed sedimentation and hydraulic geometry analyses to inform the Alviso Slough Restoration Project (Project) Environmental Impact Report (EIR) (EDAW et al. 2007a) and Engineer's Report (EDAW et al. 2007b). The purpose of these analyses is to assess how the channel width, depth, and cross-sectional area may adjust after vegetation removal and/or dredging proposed for the Alviso Slough Restoration Project Alternatives. Sedimentation potential within the project area was analyzed using PWA's MARSH98 sedimentation model and sedimentation data from the old County marina (Section 2). The sedimentation analysis informs the maintenance plan for the Project (see Operations and Maintenance section of the Engineer's Report). Empirically-based hydraulic geometry relationships were used to characterize downstream erosion potential and levee maintenance requirements due to increased tidal prism within the project areas (Section 3). The hydraulic geometry analysis was used to inform the impact assessment for the potential to increase levee erosion downstream of the project area (see HYD-2 in the EIR).

The South Bay Salt Pond (SBSP) Restoration Project proposes to restore muted tidal action at Alviso Pond A8 in the first phase of project implementation (Phase 1). The effect of the Pond A8 restoration is considered in the hydraulic geometry analysis (Section 3). The Pond A8 restoration has the potential to reduce the extent of maintenance for the Alviso Slough Restoration Project, thereby improving the sustainability of the Project. The effect of Pond A8 on Project sustainability is assessed in Section 4.

2 SEDIMENTATION ANALYSIS

The rate of sedimentation in tidal areas depends on sediment supply in the water column, settling velocities, and the period of tidal inundation. Rates of sedimentation decrease over time as mudflats and marshplains accrete and the period of tidal inundation decreases.

2.1 METHODS

Sedimentation potential was analyzed using MARSH98, a simple estuarine sedimentation model developed by PWA from methods developed by (Krone 1987). MARSH 98 simulates sedimentation based on the mass balance of suspended sediment considering the frequency and duration of tidal inundation, suspended sediment settling velocity, and accumulation of deposited material. Inputs to MARSH98 are: tide time series, sea level rise, suspended sediment concentration, and dry bulk density of deposited material, and starting elevation of the tidal area. Model output is a time series of elevations for the tidal area.

For the Alviso Slough Restoration Project, the tide time series was obtained from the mean monthly tide series for the Presidio (San Francisco) using predicted tide height and time conversions for Coyote Creek, Alviso Slough (i.e., the mouth of Alviso Slough). A value of 560 kg/m^3 was used for sediment bulk density based on Krone (1987) for pickleweed marshes in the South Bay.

The model was calibrated to observed sedimentation rates from Alviso Marina (1968-1976 and 1976-1979) (Ruth and Going Inc. et al. 1980) using the suspended sediment concentration (SSC) index, which is a calibration parameter representative of the long-term average SSC at a particular site. Marsh accretion rates are also available from cross section re-surveys in Alviso Slough (SCVWD, 1996-2004), but were not used in the sedimentation analysis. Accretion at high marshplain elevations is likely to be dominated by vegetative processes such as root mass production, which are not accounted for in the MARSH98 model.

2.2 RESULTS

The calibration curves for the MARSH98 analysis are shown in Figure 1. The calibrated SSC index for the old County marina dataset ranges from 450 to 600. Sedimentation rates for subtidal elevations (i.e., elevations below mean lower low water (MLLW), which is -2.0 ft NAVD) are constant. Sedimentation rates simulated for intertidal mudflat elevations between MLLW and the vegetation colonization elevation (approximately 1 ft above mean tide level (MTL) or 4 ft NAVD, with a range from about 0 to 2 ft above MTL or 3 to 5 ft NAVD) decrease slightly with elevation. Elevations were not simulated for high intertidal marsh elevations (i.e., elevations above the vegetation colonization elevation). Once vegetation colonizes, accretion rates are affected by processes that are not accounted for in the MARSH98 model, such as sediment consolidation, vegetation establishment and root mass production, and enhanced sediment trapping due to vegetation.

Table 1 summarizes the range in modeled sedimentation rates for subtidal and intertidal elevations. The range in sedimentation rates for intertidal elevations up to the vegetation colonization elevation is approximately 1 to 2 ft per year. This approximate range was used to inform the Project maintenance plan. Based on sedimentation rates modeled for intertidal mudflat elevations, the time for intertidal mudflats to accrete from MLLW to the vegetation colonization elevation is approximately 3 to 4.5 years.

Table 1. Summary of modeled sedimentation rates.

Elevation Range	**Sedimentation Rate**
Subtidal elevations (below MLLW or -2.0 ft NAVD)	1.5 to 2.4 ft per year
Intertidal mudflat elevations (between MLLW or -2.0 ft NAVD and 4 ft NAVD)	0.8 to 2.4 ft per year (average of 1.3 ft to 2.0 ft per year over the elevation range)
Intertidal marsh elevations (between 4 ft NAVD and MHHW or 7 ft NAVD)	Not modeled

3 HYDRAULIC GEOMETRY ANALYSIS

Vegetation removal and dredging proposed for the Project Alternatives will increase the tidal prism (volume or cumulative discharge between MLLW and MHHW) in Alviso Slough, both in the project area and downstream of the project site. Additionally, restoration of muted tidal action in Alviso Pond A8 as part of South Bay Salt Ponds Restoration Project Phase 1 Actions will further increase tidal prism in Alviso Slough. The additional tidal prism due to these two projects may cause tidal scour downstream as the channel adjusts towards a new equilibrium between channel dimensions and tidal prism. Empirical hydraulic geometry relationships between channel dimensions and tidal prism provide an estimate of potential channel widening and deepening associated with the additional tidal prism. Hydraulic geometry analysis was used to predict downstream channel dimensions for the Alviso Slough Restoration Project with and without implementation of the Pond A8 Phase 1 action.

3.1 METHODS

The scoured Alviso Slough channel dimensions expected to result from restoration actions were predicted using empirical hydraulic geometry relationships developed by Williams et al. (2002) for San Francisco Bay. These empirical relationships are based on data from historic and existing mature San Francisco Bay salt marshes ranging in size from 5 to 14,000 acres. The relationships relate channel depth, width, and cross-sectional area to tidal prism.

Channel dimensions were predicted for the Project and two possible Pond A8 implementation scenarios. The first scenario includes the additional tidal prism from a 20-ft wide notch at Pond A8. The Pond A8 notch width is 40-ft in the second scenario. Results from the Pond A8 Hydrodynamic and Geomorphic assessment (PWA 2007) were used to inform the hydraulic geometry analysis as discussed below.

Channel width, thalweg depth (below MHHW), and cross-sectional area were estimated at five locations along Alviso Slough: (1) Pond A8 notch, (2) downstream of old County marina, (3) Pond A8 bulge (4) mid-slough, and (5) at the mouth. Transect locations are shown in Figure 2. To assess the potential for either the project or Phase 1 action at Pond A8 to cause the erosion of downstream levees, the distance between levees was measured at each transect.

The existing tidal prism and additional tidal prism resulting from the Pond A8 restoration were calculated from the Pond A8 modeling results (PWA 2007) at three locations (the notch, mid-slough, and the mouth). The tidal prism for the remaining transect locations (old County marina and the Pond A8 bulge) were linearly interpolated along the channel from those tidal prisms that were modeled. Pond A8 modeling results (PWA 2007) show that tidal prism increases in Alviso Slough with the Phase 1 action at Pond A8. The effect of the Pond A8 restoration decreases from the Pond A8 notch to mid-slough (i.e., half-way between the UPRR bridge and the mouth of Alviso Slough), after which the effect of increased tidal prism is negligible. For this analysis, it is assumed that the potential for the additional tidal prism from the Project and the Pond A8 restoration to widen the slough and cause increased levee erosion downstream of the mid-slough point is not significant due to the downstream decrease in additional tidal prism and the wide band of fringing marsh between the channel and the levees in the downstream reach.

The SCVWD (2007) performed hydraulic modeling of the 100-year fluvial flood event for the Project Alternatives, but did not model typical tidal conditions that would give an estimate of the additional tidal prism from the Project. For this analysis, the additional tidal prism from the Project was estimated as the full potential tidal prism due to vegetation and sediment removal. For each alternative, the additional potential tidal prism was calculated as the volume of material excavated from within the intertidal zone (MHHW-MLLW). As vegetation and root mass removal may lower the marshplain by approximately one to four feet, the range in additional potential tidal prism corresponding to one- and four-foot removal depths was calculated. We assumed that the calculated additional tidal prism would be mobilized at each of the cross-sections downstream of the project area. This approach is expected to over-estimate the additional tidal prism, but is used as a conservative estimate to assess the potential for channel widening in the absence of more detailed modeling results. The sum of the existing modeled tidal prism and additional incremental tidal prism due to either the Alviso Slough Restoration Project or Pond A8 Phase 1 action was used in the hydraulic geometry relationships to predict changes to channel morphology.

Because there is scatter in the empirical data set used to develop the hydraulic geometry relationships, the dimensions of measured channel cross-sections are not expected to exactly match those predicted using the hydraulic geometry equations. This is the case for Alviso Slough, where the dimensions predicted by the hydraulic geometry based on the existing tidal prism predict a shallower, wider channel at the upstream cross-section and a deeper, narrower channel at the mid-slough cross-section. Because there may be a physical basis for the deviation from predicted dimensions, for example the effects of fluvial flows from the Guadalupe River, the differences between predicted and measured dimensions for existing conditions were preserved in the predicted channel dimension estimates. Long-term channel dimensions were calculated as the sum of the existing measured dimensions and the predicted incremental change due to the Alviso Slough project and the Pond A8 restoration. Increases in each channel dimension were calculated using the derivatives of the hydraulic geometry equations. These increases in channel size were then added to the measured existing dimensions to estimate the new equilibrium geometry of Alviso Slough. The equation below was used to evaluate the channel dimensions resulting from Phase 1 actions:

$$D_2 = D_1 + \left(\left. \frac{dD}{dTP} \right|_{TP_1 + \frac{\Delta TP}{2}} \right) (\Delta TP)$$

where D = channel depth, TP = tidal prism, subscript 1 refers to existing conditions, and subscript 2 refers to post-project conditions, and $\Delta TP = TP_2 - TP_1$. Calculations were completed in metric units and converted to feet.

3.2 RESULTS AND DISCUSSION

The results of the hydraulic geometry analysis for each alternative are presented in Table 2 through Table 6. The existing channel dimensions for each transect are included in Table 2 for comparison to the post-project predicted dimensions and the two Pond A8 scenarios (20 ft and 40 ft notch). The minimum distance between levees for each reach is noted to assess the potential for downstream levee erosion due to tidal scour. The results suggest that at some locations downstream of the project area (particularly the old Alviso County Marina), the scoured channel dimensions approach the minimum distance between levees. This is particularly true for the Alternative 5, which mobilizes the largest tidal prism. These results were used to evaluate the potential impact of increasing levee erosion downstream of the project area in the EIR (see Impact HYD-2).

Note that channel scour is inherently difficult to predict, and hydraulic geometry is only a rough prediction tool. Hydraulic geometry predictions contain a large amount of uncertainty. It is not possible to predict whether channel widening would occur preferentially on one side of the channel or the other. The exact location of channel scour with respect to the centerline cannot be estimated. Also, there is evidence that channel widening downstream of levee breaches is less than would be predicted using hydraulic geometry relationships (2002).

As discussed in Section 3.1, the range in calculated tidal prism and channel dimensions account for the range of possibly depths for vegetation and root mass removal (one to four feet). Note that the range in the results does not account for uncertainty inherent to the hydraulic geometry predictions.

Table 2. Summary of Existing and Predicted Slough Geometry - Alternative 1

Scenario	Additional Tidal Prism (ac-ft)	Tidal Prism in Slough (ac-ft)	Channel Depth (ft)	Channel Width (ft)	Channel XS Area (ft^2)
Pond A8 Notch transect (328 feet between levees)					
Measured Existing Conditions	0	208	14.5	131	1210
Predicted with Alt. 1 (2.6 acres)	3-10	211-218	14.5-14.6	132-134	1218-1242
Predicted with Phase 1 Actions (20 ft notch)	205	416-423	15.9-16.0	187-188	1767-1785
Predicted with Phase 1 Actions (40 ft notch)	410	621-628	16.8	226-227	2211-2227
Downstream of old County marina (230 feet between levees)					
Measured Existing Conditions	0	276	13.9	131	1086
Predicted with Alt. 1 (2.6 acres)	3-10	279-286	13.9	132-134	1093-1115
Predicted with Phase 1 Actions (20 ft notch)	182	461-468	15.0	176-178	1553-1571
Predicted with Phase 1 Actions (40 ft notch)	365	644-654	15.7	211-212	1946-1962
Pond A8 Bulge (308 ft between levees)					
Measured Existing Conditions	0	436	13.1	157	1366
Predicted with Alt. 1 (2.6 acres)	3-10	439-446	13.1-13.2	158-159	1372-1391
Predicted with Phase 1 Actions (20 ft notch)	128	567-574	13.7	184-186	1662-1679
Predicted with Phase 1 Actions (40 ft notch)	257	696-703	14.2	207-209	1931-1946
Mid-Slough Transect (755 feet between levees)					
Measured Existing Conditions	0	632	13.5	246	1905
Predicted with Alt. 1 (2.6 acres)	3-10	635	13.5	246-248	1910-1927
Predicted with Phase 1 Actions (20 ft notch)	63	698	13.7-13.8	258-259	2040-2056
Predicted with Phase 1 Actions (40 ft notch)	126	761	14.0	268-270	2165-2180

Table 3. Summary of Existing and Predicted Slough Geometry - Alternative 2

Scenario	Additional Tidal Prism (ac-ft)	Tidal Prism in Slough (ac-ft)	Channel Depth (ft)	Channel Width (ft)	Channel XS Area (ft^2)
Pond A8 Notch transect (328 feet between levees)					
Measured Existing Conditions	0	208	14.5	131	1210
Predicted with Alt. 2 (7.0 acres)	7-28	215-236	14.6-14.8	133-140	1232-1295
Predicted with Phase 1 Actions (20 ft notch)	205	420-441	16.0-16.1	188-192	1777-1826
Predicted with Phase 1 Actions (40 ft notch)	410	625-646	16.8	227-230	2220-2262
Downstream of old County marina (230 feet between levees)					
Measured Existing Conditions	0	276	13.9	131	1086
Predicted with Alt. 2 (7.0 acres)	7-28	283-304	14.0-14.1	133-139	1106-1163
Predicted with Phase 1 Actions (20 ft notch)	182	465-486	15.0-15.1	177-181	1563-1611
Predicted with Phase 1 Actions (40 ft notch)	365	648-669	15.8	212-215	1955-1997
Pond A8 Bulge (308 ft between levees)					
Measured Existing Conditions	0	436	13.1	157	1366
Predicted with Alt. 2 (7.0 acres)	7-28	443-464	13.1-13.2	159-163	1383-1432
Predicted with Phase 1 Actions (20 ft notch)	128	571-592	13.7-13.8	185-189	1672-1717
Predicted with Phase 1 Actions (40 ft notch)	257	700-721	14.2-14.3	208-212	1939-1981
Mid-Slough Transect (755 feet between levees)					
Measured Existing Conditions	0	632	13.5	246	1905
Predicted with Alt. 2 (7.0 acres)	7-28	639-660	13.5-13.6	247-251	1920-1963
Predicted with Phase 1 Actions (20 ft notch)	63	702-723	13.8	258-262	2049-2091
Predicted with Phase 1 Actions (40 ft notch)	126	765-786	14.0	269-272	2174-2214

Table 4. Summary of Existing and Predicted Slough Geometry - Alternative 3

Scenario	Additional Tidal Prism (ac-ft)	Tidal Prism in Slough (ac-ft)	Channel Depth (ft)	Channel Width (ft)	Channel XS Area (ft^2)
Pond A8 Notch transect (328 feet between levees)					
Measured Existing Conditions	0	208	14.5	131	1210
Predicted with Alt. 3 (3.7 acres)	30	238	14.8	141	1299
Predicted with Phase 1 Actions (20 ft notch)	205	443	16.1	192	1830
Predicted with Phase 1 Actions (40 ft notch)	410	648	16.8	230	2265
Downstream of old County marina (230 feet between levees)					
Measured Existing Conditions	0	276	13.9	131	1086
Predicted with Alt. 3 (3.7 acres)	30	306	14.1	139	1167
Predicted with Phase 1 Actions (20 ft notch)	182	488	15.1	182	1614
Predicted with Phase 1 Actions (40 ft notch)	365	671	15.8	215	2000
Pond A8 Bulge (308 ft between levees)					
Measured Existing Conditions	0	436	13.1	157	1366
Predicted with Alt. 3 (3.7 acres)	30	466	13.3	163	1436
Predicted with Phase 1 Actions (20 ft notch)	128	594	13.8	189	1720
Predicted with Phase 1 Actions (40 ft notch)	257	723	14.3	212	1984
Mid-Slough Transect (755 feet between levees)					
Measured Existing Conditions	0	632	13.5	246	1905
Predicted with Alt. 3 (3.7 acres)	30	662	13.6	251	1966
Predicted with Phase 1 Actions (20 ft notch)	63	725	13.8	262	2094
Predicted with Phase 1 Actions (40 ft notch)	126	788	14.0	273	2218

Table 5. Summary of Existing and Predicted Slough Geometry - Alternative 4

Scenario	Additional Tidal Prism (ac-ft)	Tidal Prism in Slough (ac-ft)	Channel Depth (ft)	Channel Width (ft)	Channel XS Area (ft^2)
Pond A8 Notch transect (328 feet between levees)					
Measured Existing Conditions	0	208	14.5	131	1210
Predicted with Alt. 4 (6.2 acres)	58	266	15.0	149	1380
Predicted with Phase 1 Actions (20 ft notch)	205	471	16.2	198	1893
Predicted with Phase 1 Actions (40 ft notch)	410	676	16.9	235	2319
Downstream of old County marina (230 feet between levees)					
Measured Existing Conditions	0	276	13.9	131	1086
Predicted with Alt. 4 (6.2 acres)	58	334	14.3	147	1242
Predicted with Phase 1 Actions (20 ft notch)	182	516	15.3	187	1677
Predicted with Phase 1 Actions (40 ft notch)	365	699	15.9	220	2055
Pond A8 Bulge (308 ft between levees)					
Measured Existing Conditions	0	436	13.1	157	1366
Predicted with Alt. 4 (6.2 acres)	58	494	13.4	169	1500
Predicted with Phase 1 Actions (20 ft notch)	128	622	13.9	194	1779
Predicted with Phase 1 Actions (40 ft notch)	257	751	14.4	217	2039
Mid-Slough Transect (755 feet between levees)					
Measured Existing Conditions	0	632	13.5	246	1905
Predicted with Alt. 4 (6.2 acres)	58	690	13.7	256	2024
Predicted with Phase 1 Actions (20 ft notch)	63	753	13.9	267	2149
Predicted with Phase 1 Actions (40 ft notch)	126	816	14.1	277	2271

Table 6. Summary of Existing and Predicted Slough Geometry - Alternative 5

Scenario	Additional Tidal Prism (ac-ft)	Tidal Prism in Slough (ac-ft)	Channel Depth (ft)	Channel Width (ft)	Channel XS Area (ft^2)
Pond A8 Notch transect (328 feet between levees)					
Measured Existing Conditions	0	208	14.5	131	1210
Predicted with Alt. 5 (25 acres)	105-151	313-359	15.3-15.6	162-174	1511-1629
Predicted with Phase 1 Actions (20 ft notch)	205	518-564	16.4-16.6	208-216	1999-2096
Predicted with Phase 1 Actions (40 ft notch)	410	723-769	17.1-17.2	242-249	2410-2495
Downstream of old County marina (230 feet between levees)					
Measured Existing Conditions	0	276	13.9	131	1086
Predicted with Alt. 5 (25 acres)	105-151	381-427	14.6-14.8	158-169	1363-1475
Predicted with Phase 1 Actions (20 ft notch)	182	563-609	15.5-15.6	197-205	1780-1876
Predicted with Phase 1 Actions (40 ft notch)	365	746-792	16.1-16.2	227-234	2146-2232
Pond A8 Bulge (308 ft between levees)					
Measured Existing Conditions	0	436	13.1	157	1366
Predicted with Alt. 5 (25 acres)	105-151	541-587	13.6-13.8	179-188	1607-1707
Predicted with Phase 1 Actions (20 ft notch)	128	669-715	14.1-14.3	203-211	1878-1970
Predicted with Phase 1 Actions (40 ft notch)	257	798-844	14.5-14.7	224-231	2131-2216
Mid-Slough Transect (755 feet between levees)					
Measured Existing Conditions	0	632	13.5	246	1905
Predicted with Alt. 5 (25 acres)	105-151	737-783	13.9-14.0	264-272	2119-2209
Predicted with Phase 1 Actions (20 ft notch)	63	800-846	14.1-14.2	275-282	2242-2329
Predicted with Phase 1 Actions (40 ft notch)	126	863-909	14.3-14.4	285-292	2361-2446

4 PROJECT SUSTAINABILITY

Within the project area, Alviso Slough would tend to fill in with sediment and approach the existing channel dimensions after it is enlarged as proposed in Alternatives 1 to 5. The Alviso Slough project alone would not sustain enlarged channel dimensions over the long-term without on-going maintenance. The increase in tidal prism from the Pond A8 Phase 1 Action has the potential to sustain Alviso Slough channel dimensions within the project area that are larger than the existing dimensions.

The sustained increase in width resulting from the Pond A8 Phase 1 Action shown in Table 7 may reduce the width of future vegetation removal and dredging to maintain channel dimensions for Alternatives 1 to 5. For example, assuming the Pond A8 is operated with a 40 ft notch, the removal width for future maintenance may be reduced by up to approximately 95 ft (from Table 7). In this scenario, the width of vegetation removal required to maintain Alternative 1 channel dimensions would decrease from 110 ft to approximately 15 ft.

Table 7. Potential long-term sustained increase in Alviso Slough channel width due to Pond A8 restoration scenarios.

Scenario	Additional Tidal Prism (ac-ft)	Tidal Prism in Slough (ac-ft)	Channel Width (ft)	Sustained Increase in Channel Width (ft)
Pond A8 Notch transect				
Measured Existing Conditions	0	208	131	-
Predicted with Pond A8 Phase 1 Action (20 ft notch)	205	413	186	55
Predicted with Pond A8 Phase 1 Action (40 ft notch)	410	618	226	95
Downstream of old County marina				
Measured Existing Conditions	0	276	131	-
Predicted with Pond A8 Phase 1 Action (20 ft notch)	182	458	177	46
Predicted with Pond A8 Phase 1 Action (40 ft notch)	365	641	209	78

LIST OF FIGURES

Figure 1. MARSH98 sedimentation curves for Alviso Slough.
Figure 2. Location of Alviso Slough transects.

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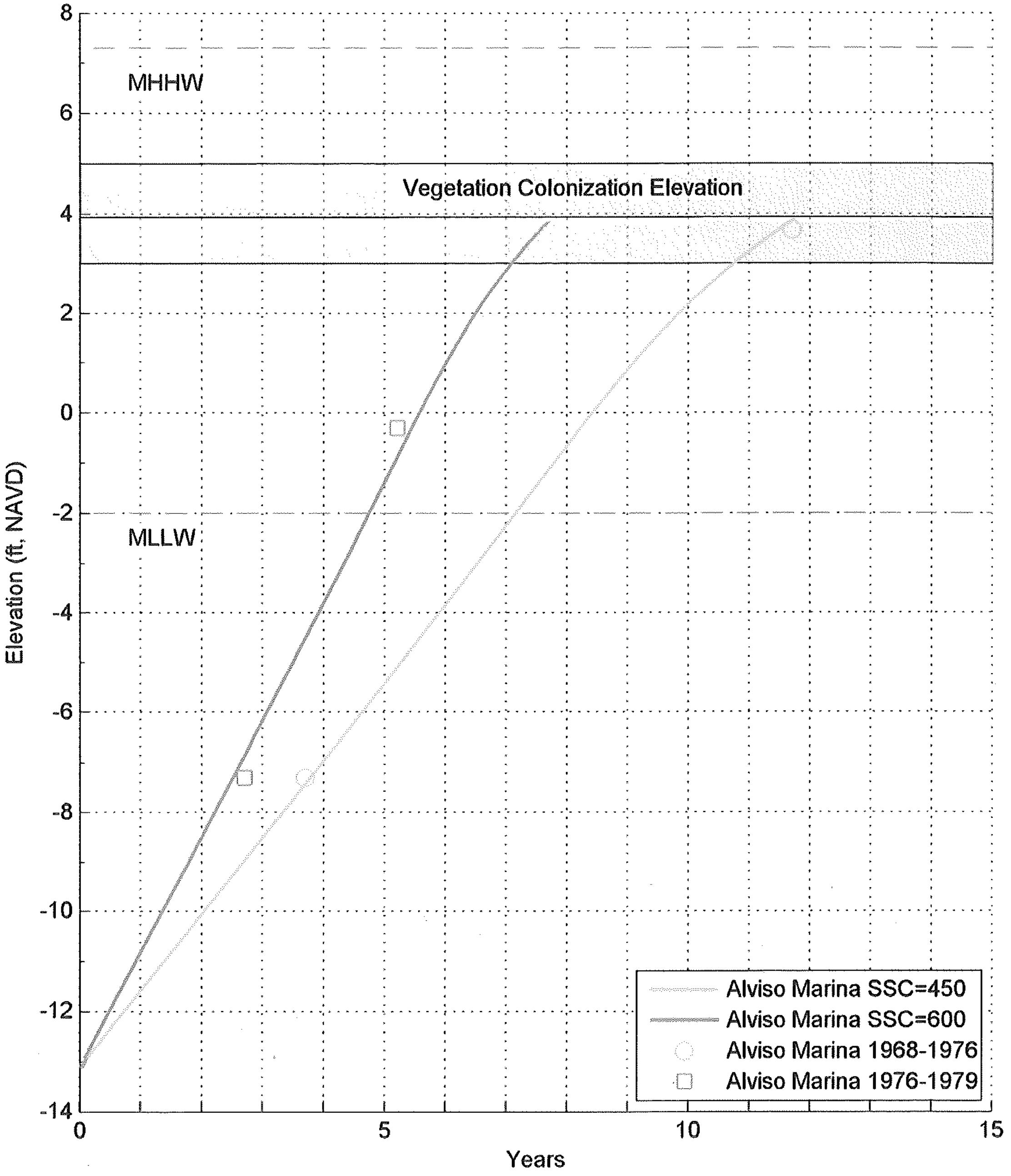


Source: MARSH98 model results

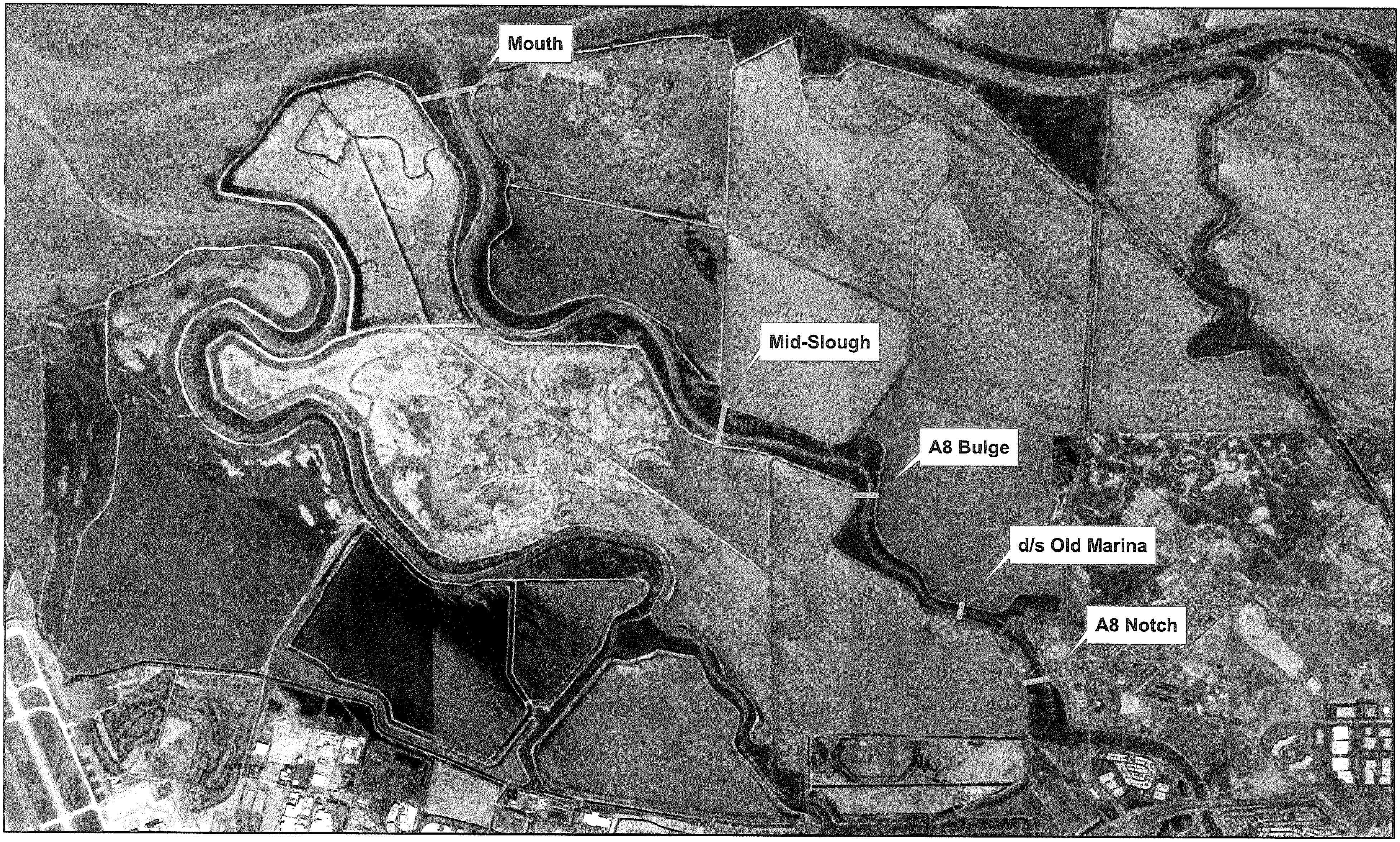
figure 1

Alviso Slough Restoration Project

MARSH98 Calibration Curves for Alviso Slough

PWA Ref# 1840

PWA



Source: IKONOS Imagery

figure 2

Alviso Slough Restoration Project

Alviso Slough Transect Locations

PWA Ref# 1840

PWA

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Appendix D

Alviso Slough Conceptual Model Technical Memorandum

MEMORANDUM

Date:	May 14, 2007
To:	Elke Rank
Organization:	EDAW
From:	Don Danmeier, Julie Stephenson, David Brew, and Michelle Orr
PWA Project #:	1840
PWA Project Name:	Alviso Slough Restoration Project
Subject:	A Conceptual Model of the Evolution of Alviso Slough
Copy(ies) To:	Bal Ganjoo (SCVWD)

WHAT IS A CONCEPTUAL MODEL?

A conceptual model is an explicit simplified description of cause and effect linkages. It explains how we think important features of natural systems respond to changing processes, particularly those affected by human activity. A well founded conceptual model can be used to establish a common understanding among different stakeholders and provides a rationale for the development of management alternatives.

OVERVIEW OF THE CONCEPTUAL MODEL OF ALVISO SLOUGH

The Alviso Slough channel (Figure 1) is shaped by a combination of river, or 'fluvial', and tidal processes. These forces both deliver sediments to the slough channel and scour away previously deposited material. Human-induced, or 'anthropogenic', changes to the landscape have altered the balance between these depositional and erosive forces, which in turn shapes the long-term size and form of the slough. In addition to land use changes that have directly affected Alviso Slough and lower Guadalupe River, the slough channel has been subject to larger processes in the far South San Francisco Bay and Santa Clara Valley.

The conceptual model below describes the fluvial and tidal processes shaping Alviso Slough, and the effects of past land use practices that have resulted in direct and indirect changes to the size and shape of the slough channel.

DEFINING THE GEOMORPHIC CHANNEL

From a geomorphic perspective, there are many differences in how fluvial and tidal processes shape Alviso Slough (Table 1). Flood tidal flows (i.e., flows during the incoming or rising tide) deliver cohesive mud from the Bay to the slough and fringing marsh which deposit as currents slacken. If ebb tidal currents (i.e., currents during the receding or falling tide) are sufficiently strong, some or all of the mud deposited along the channel bottom is swept back into the Bay, but fine sediment deposited on the marsh plain remains. As shown in Figure 2, the influence of tidal fluctuations extends along the relatively flat portion of Alviso Slough / Guadalupe River from the Bay to approximately Montague Bridge (CH2M HILL 2001).

In contrast to tidal flows, which generally transport fine sediment, fluvial flows transport and deposit a wide range of sediment sizes. The vast majority of fluvial sediments are transported during large winter storms, when flows along the Guadalupe River are high enough to move sand and gravel downstream. The channel-forming flow, or 'dominant discharge', of rivers generally has a return period of 1.5 to 2 years (Wolman and Leopold 1957).

Table 1. Characteristics of Tidal and Fluvial Flows

Tidal Flows	**Fluvial Flows**
Bidirectional	Unidirectional
Predictable and periodic	Random occurrence of major floods. Seasonal variation of low flows
Relátively small variations throughout the year	Large variation with the vast majority of flow and sediment transport occurring during infrequent events following major rainfall
Scouring action confined below high tide level	Scouring action occurs in the entire channel
Capable of transporting sediment upstream	Sediment transport moves downstream only
Transports predominantly fine sediment (silt & clay)	Transports a wide range of sediment sizes

An important feature of river and slough systems is their ability to adjust their width, depth, slope, and sediment discharge until a delicate balance between the flow of water and sediment movement is achieved (Langein and Leopold 1964). Natural systems generally maintain this dynamic equilibrium between continually changing erosive and depositional forces. Hence, the morphology of Alviso Slough reflects direct human modifications to the landscape (e.g., diking, dredging etc.) and changes in the fluvial and tidal processes that shape the slough channel, due to either natural variability (e.g., winter storms) or indirect human impacts (e.g., construction of upstream reservoirs).

Tidal Processes

San Francisco Bay experiences mixed diurnal tides typical of the West Coast, with two unequal high tides and two unequal low tides every 24 hours and 50 minutes. The published 1976 tidal datums for Alviso Slough suggest that the tidal range at Gold Street Bridge is slightly higher than at the mouth of the slough. However, more recent data collected during 2004 indicate that the tidal range at Gold Street Bridge is now less than the tidal range at the mouth of the slough (Figure 3). Presumably, this reduction of tidal range along the upstream reach of Alviso Slough over the past few decades is a result of changes in the channel morphology over this period of time. Numerical modeling indicates that the volume of water routed along Alviso Slough during ebb and flood tides, or 'tidal prism', gradually diminishes landward, from about 1,200 ac-ft at its mouth to approximately 200 ac-ft at Gold Street Bridge (Figure 4). Since the depth, width and cross-sectional area of tidal channels vary proportionally with tidal prism (Williams et al. 2001), the slough channel shows a gradual reduction in dimensions upstream over this reach (Figure 5).

Sediment along the bed and bank of Alviso Slough and the tidally influenced reach of Guadalupe Slough is comprised mostly of silt and clay (CH2M HILL 2001), although observations from recent sediment coring indicate buried layers of gravel/cobble in the upper (landward half) slough and fine gravel/coarse sand in the lower (bayward half) slough (Josh Collins, personal communication). These observations suggest that the primary source of the accumulated sediment is estuarine, although infrequent flood discharges from the Guadalupe River also deliver watershed sediment with the relative contribution of fluvial delivery to net sedimentation diminishing downstream.

Suspended estuarine sediments in the far South Bay are swept into Alviso Slough by strong flood-tide currents, some of which deposit on the high-tide slack. The relatively weak ebb-tide currents shown in Figure 6 are unable to fully remove all of the deposited sediment, and the asymmetry in tidal current velocities results in a net import of estuarine sediment. Sediment accumulation over mudflats (Foxgrover et al. 2004) and high values of suspended sediment concentrations, relative to other portions of San Francisco Bay (Schoellhamer 2002), reflect an abundant supply of estuarine sediment in the far South Bay.

As sedimentation continues and the channel banks reach a high enough elevation relative to the tides, pioneer plant colonization occurs. Once established, marsh plants increase the trapping efficiency of silt and clay entrained in the water and contribute organic material to the channel banks. Based on measured rates of sedimentation along the marsh fringing the banks of Alviso Slough and a numerical model of vertical marsh accretion, Krone (1998) estimated an effective suspended sediment concentration (SSC) of approximately 240 mg/l. Higher effective SSC values of 450-600 mg/l were predicted by PWA (PWA et al. 2005) using the same methods, for the abandoned Alviso Marina, presumably due to greater sheltering from tidal currents and lower bed elevations that provided longer periods of tidal inundation.

Fluvial Processes

Alviso Slough is the tidal portion of the Lower Guadalupe River extending 12,000 ft from the Bay to approximately Montague Bridge (CH2M HILL 2001). The non-tidal Guadalupe River extends upstream from the bridge to its headwaters in the Santa Cruz Mountains. The Guadalupe River watershed encompasses approximately 170 square miles in which there are five main tributaries: Los Gatos Creek, Ross Creek, Guadalupe Creek, Alamitos Creek and Canaos Creek. Basin relief is approximately 3,800 ft, with the highest point near Loma Prieta in the Santa Cruz Mountains and the lowest point near Alviso at the Bay. The basin is characterized by a perimeter of high, steep, natural slopes with a large wide valley below (CH2M HILL 2001).

The hydrology of the watershed has been greatly altered by human activity, including groundwater withdrawal in response to urbanization and agricultural development. In response to land surface subsidence in and around San Jose caused by groundwater withdrawals, the District constructed groundwater recharge ponds and four dams and reservoirs in the Guadalupe River basin. The dams forming Calero, Almaden and Guadalupe Reservoirs were completed in 1935, and the dam forming Lexington Reservoir was completed in 1952 (CH2M HILL 2001). The four reservoirs were primarily built to store water for supply and have a combined storage capacity of 15 x 10^8 cubic feet and control a sub-basin of 63 square miles (40% of the watershed) (CH2M HILL 2001).

Average annual precipitation varies from 14-16 inches in the lower, urbanized regions of the watershed, to 28-44 inches in the higher, mountainous regions (McKee et al. 2004). Annual runoff in the Lower Guadalupe River for the water years 1971 through 2000 varied from 3–282 cfs with a daily average of 61.8 cfs (McKee and others 2004). The majority of runoff (approximately 90%) occurs between November and April. The estimated 100-year flood discharge on the Guadalupe River at Interstate 880 is 17,000 cfs, with 5- and 2-year flows approximately 6,700 and 2,300 cfs respectively (CH2M HILL 2001).

Fluvial sediment transport primarily takes place during floods, when sediment of all sizes is transported down the non-tidal part of the Guadalupe River. Where the Guadalupe River enters the tidal zone, its slope abruptly shallows (Figure 2), causing a decrease in sediment transport capacity that results in significant gravel deposition. This is reflected by gravel deposits on the bed of the low flow channel, small gravel bars, and occasional steep eroded banks immediately upstream of the tidal zone.

HISTORIC EVOLUTION OF ALVISO SLOUGH

The Santa Clara Valley experienced regional land subsidence since at least 1906 (CH2M HILL 2001), (Figure 7) much of which is attributable to large-scale groundwater withdrawals. Subsidence was largely arrested by the mid-1960s, when State water deliveries began to arrive in the San Jose area. Land subsidence along the Guadalupe River was not uniform, at least during the period of measurements between 1934 and 1967 (Poland and Ireland 1988). Subsidence was greatest in San Jose where over twelve feet was recorded between 1916 and 1967. Subsidence was less at Alviso but probably exceeded several feet by the time groundwater recharge had arrested land movements.

Historically, Alviso Slough drained a large area of tidal marsh in the far South Bay. Under natural conditions, the Guadalupe River did not drain to the Bay via Alviso Slough, but rather through Guadalupe Slough. By the time salt pond levees were constructed in the 1940s, which isolated Alviso Slough from its tributary tidal marsh, the slough had been joined to the Guadalupe River by a human modifications to the channel system. These activities altered the hydrodynamics driving the equilibrium form of the slough at the time by reducing its tidal prism and introducing freshwater flows. Slough channels naturally fill in with sediment as they trend toward a smaller cross-sectional area in equilibrium with decreased tidal prisms. Figure 8 shows that the Alviso Slough channel depth has decreased significantly following the construction of the salt ponds, although there is substantial variability both spatially and temporally.

The natural sinuosity of the Lower Guadalupe River upstream of Alviso Slough was modified significantly in the mid-1960s to create a managed floodway. In order to develop the adjacent land (formerly the river floodplain), the channel between Tasman Road and just downstream of the UPRR Bridge was straightened and lined with levees, constructed to protect the adjacent development from flood hazards. Overall, straightening and levee construction reduced the reach length by approximately 25% and increased the channel gradient (CH2M HILL 2001). While the levees were constructed to increase water conveyance in the channel, they severed the connection between the river and its floodplain and altered the natural morphology. The channel cross-sectional geometry in the straightened reaches of the river is presently narrower and deeper than under historic natural river conditions.

There is little detailed information available on historic dredging activities in Alviso Slough. The San Francisco Bay Conservation and Development Commission maintain records of three permitted maintenance dredging events in Alviso Slough in 1968, 1976 and 1980. The dredge limits for all three dredging events were entirely within the old Alviso marina. Each time, the old marina was dredged to a depth of approximately -10 ft MSL in order to maintain draft depths for boats. After each dredging event, rapid sedimentation occurred (~1-2 ft/year). Presumably, the costs of maintaining the marina became too expensive and dredging was discontinued after 1980. The old marina is located in a small embayment off the main channel of Alviso Slough, where quiet conditions facilitated higher rates of sedimentation than would naturally occur along the more dynamic channel. While dredging of the old marina did not significantly affect the morphology of Alviso Slough, the high rates of sedimentation measured after dredging indicates that sediment was readily available for deposition.

The high rates of sedimentation recorded at the old marina are consistent with other sedimentation trends in the far South Bay and with regional erosion and deposition trends observed over the last century. Sedimentation data reviewed from Palo Alto Yacht Harbor and Warm Springs Marsh indicates that rates are high in the very far South Bay (1-2 ft/year). Other restoration sites further north (e.g., Cooley Landing and Stevens Creek marsh) indicate net sedimentation but at a slower rates. General changes in

Bay bathymetry over the last century also indicate that the far South Bay has consistently remained a depositional environment, while other parts of the South Bay have experienced periods of erosion and deposition. In addition, the amount of deposition observed in the far South Bay exceeds the potential contribution from local tributaries. These regional observations support the notion that the net transport of sediment is from north to south in the South San Francisco Bay, and that the sediment is deposited in the far South Bay.

Sedimentation along the slough in the old Alviso marina has resulted in a gradual expansion of marsh vegetation. Species composition has also changed over this time period, with conversion from salt to brackish plants and newly-formed freshwater marsh habitat in areas upstream of the old Alviso marina. These changes in vegetation suggest that the gradual reduction in channel cross-sectional area and tidal prism along the landward reach of Alviso Slough has increased the influence of freshwater discharges from lower Guadalupe River in structuring marsh plant communities in this area (H. T. Harvey & Associates 2005).

PRESENT MORPHOLOGY OF ALVISO SLOUGH

The present morphology of Alviso Slough indicates that it continues to adjust to the historical reduction in the volume of the tidal prism. As with most other tidal sloughs within the far South Bay, Alviso Slough downstream of Montague Bridge is filling in with readily available estuarine sediment. The present morphologic trajectory shows that accumulation is occurring along the channel banks and fringing marshplain, narrowing the channel and steepening the channel bank slopes (Figure 5). Additional cross-sections confirm that the process of 'thalweg deepening' has occurred further upstream of the Alviso Marina Transect shown in Figure 5 between 1996 and 2004.

Between Montague Expressway and downstream of the old Alviso marina, the channel thalweg is also deepening (Figure 5 and Figure 8). One of the potential reasons for thalweg deepening in this region may be related to changes in fluvial processes brought about by upstream channelization. The longitudinal profile of the channel thalweg (Figure 2) shows an abrupt drop in thalweg elevation in the reach where channel deepening is observed upstream of the UPRR Bridge. The abrupt drop in thalweg elevation could be a nickpoint that formed after channelization of the river upstream in the mid-1960s, although it is unclear as to whether incision due to upstream nickpoint migration is still occurring and whether channel deepening in the upper portion of Alviso Slough as observed in the cross-sections is related to the nickpoint at all.

IMPLICATIONS FOR MANAGEMENT INTERVENTION

The active physical processes and changing morphology of Alviso Slough have several implications for future management of the slough. Changes to the relative balance between depositional and erosive processes will be required for intervention measures to sustain larger open water channel area without ongoing maintenance. The paragraphs below discuss implications for specific management interventions proposed as part of the Alviso Slough Restoration Project and the Phase 1 action currently planned for Pond A8 as part of the South Bay Salt Pond (SBSP) Restoration Project.

- *No Action.* Assuming no intervention is taken, Alviso Slough would continue to accumulate sediment and narrow until equilibrium is reached with the upstream tidal prism and fluvial flows. Mudflat and subtidal habitats would continue to convert to fringing marsh. It is likely that thalweg deepening would also continue along the slough upstream of the Old Alviso Marina in response to upstream channelization until a new equilibrium depth is attained.

- *Vegetation Removal.* Excavation of existing tidal marsh away from the edges of the channel (with or without dredging) would provide a short-term increase in the channel width. However, these increases would not be sustainable over the longer term because bay water would continue to provide an ample supply of marsh-building sediment to this highly depositional environment. Tidal currents would remain relatively small and not provide sufficient erosive power to remove sediment deposited on the areas mechanically removed of vegetation. Contemporary rates of marsh plain accretion and past experience with vegetation removal immediately upstream of the project area suggest that vegetation would rapidly colonize areas cleared of vegetation

- *Dredging.* Dredging in areas subject to mechanical vegetation removal could lower the slough bed to subtidal elevations. While this action would prevent rapid vegetation colonization, the deepened portions of Alviso Slough would act as a sediment sink. Estuarine sediment would accumulate in dredged areas at a relatively high rate since tidal currents would be too low to remobilize sediment deposited from the water column during slack tides. Vegetation colonization would occur once accretion raised the slough bed to the appropriate intertidal elevation. Therefore, the dredge depth would directly affect the duration of open water channel habitat.

- *Pond A8 Breaching.* A self-sustaining larger subtidal channel in upper Alviso Slough would require dredging and/or vegetation removal to be coupled with tidal restoration at Pond A8. Tidal restoration at this pond would increase current velocities and possibly modify sediment dynamics within the slough (i.e. diminish the dominance of flood-tide currents, and hence reduce the net transport of estuarine sediments upstream, as indicated by numerical modeling performed for the SBSP Restoration Project).

  Current SBSP plans call for partial tidal restoration initially, but subsequent phases of implementation could restore full tidal action to Pond A8 if ecological risks are proven to be acceptable and new flood protection levees are constructed. Partial tidal restoration of Pond A8 would sustain a slightly wider (current predictions are 50-90 ft wider) and deeper (up to 2 ft deeper along the thalweg) channel in locations just downstream of the connection between Alviso Slough and Pond A8. Depending on the location of the connection, this could include portions of the South Bay Yacht Club facilities along Alviso Slough. Therefore, this Phase 1 SBSP action would likely sustain at least a portion of the mechanically widened channel but not maintain dredged portions at their constructed elevation. Full tidal restoration at Pond A8 would sustain a substantially wider and deeper channel along portions of Alviso Slough downstream of breaches in the Pond A8 perimeter levee.

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Figure 6	Tidal Currents Modeled in Alviso Slough
Figure 7	Historic Photographs of SBYC
Figure 8	Alviso Slough Thalweg Evolution

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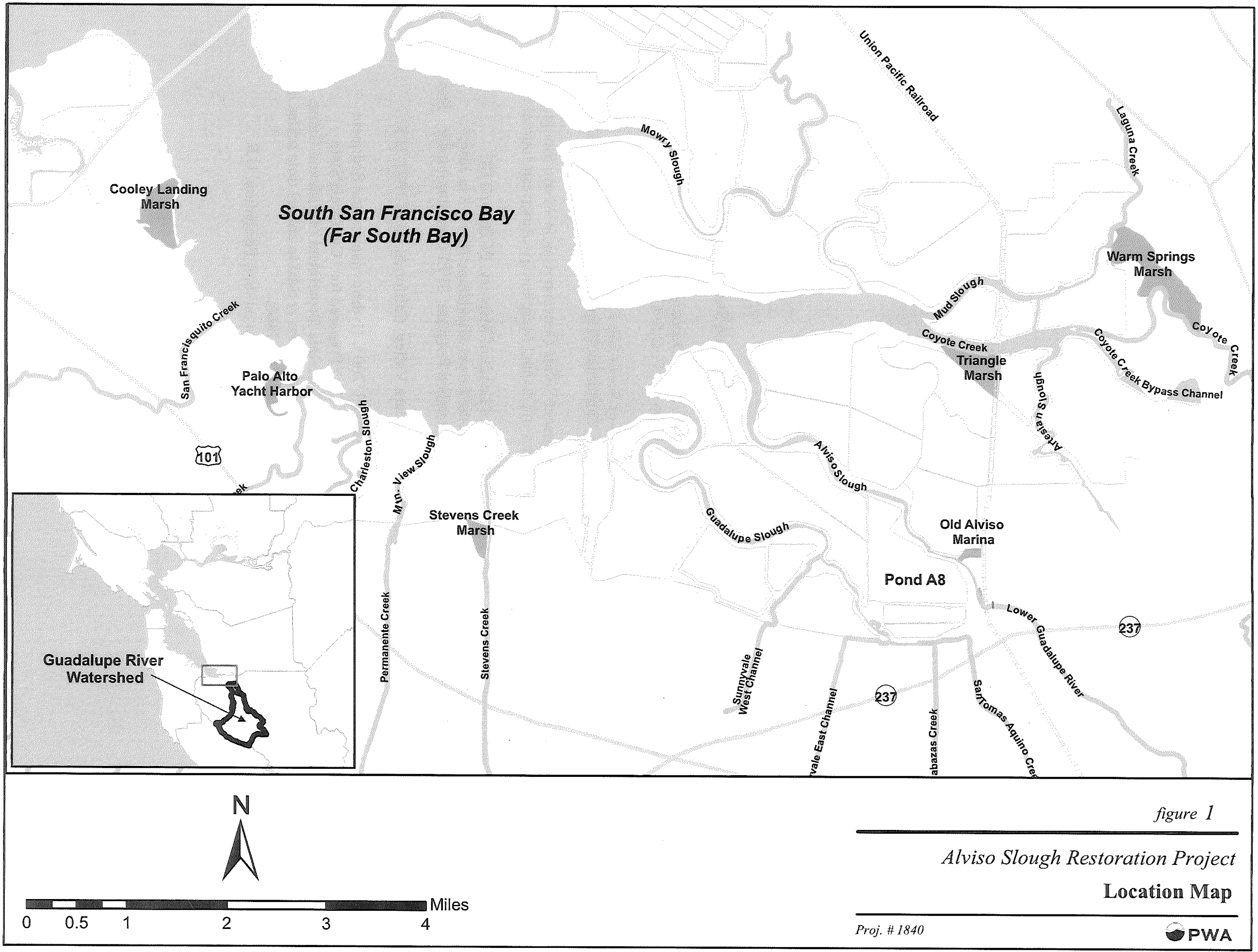

figure 1

Alviso Slough Restoration Project

Location Map

Proj. # 1840

PWA

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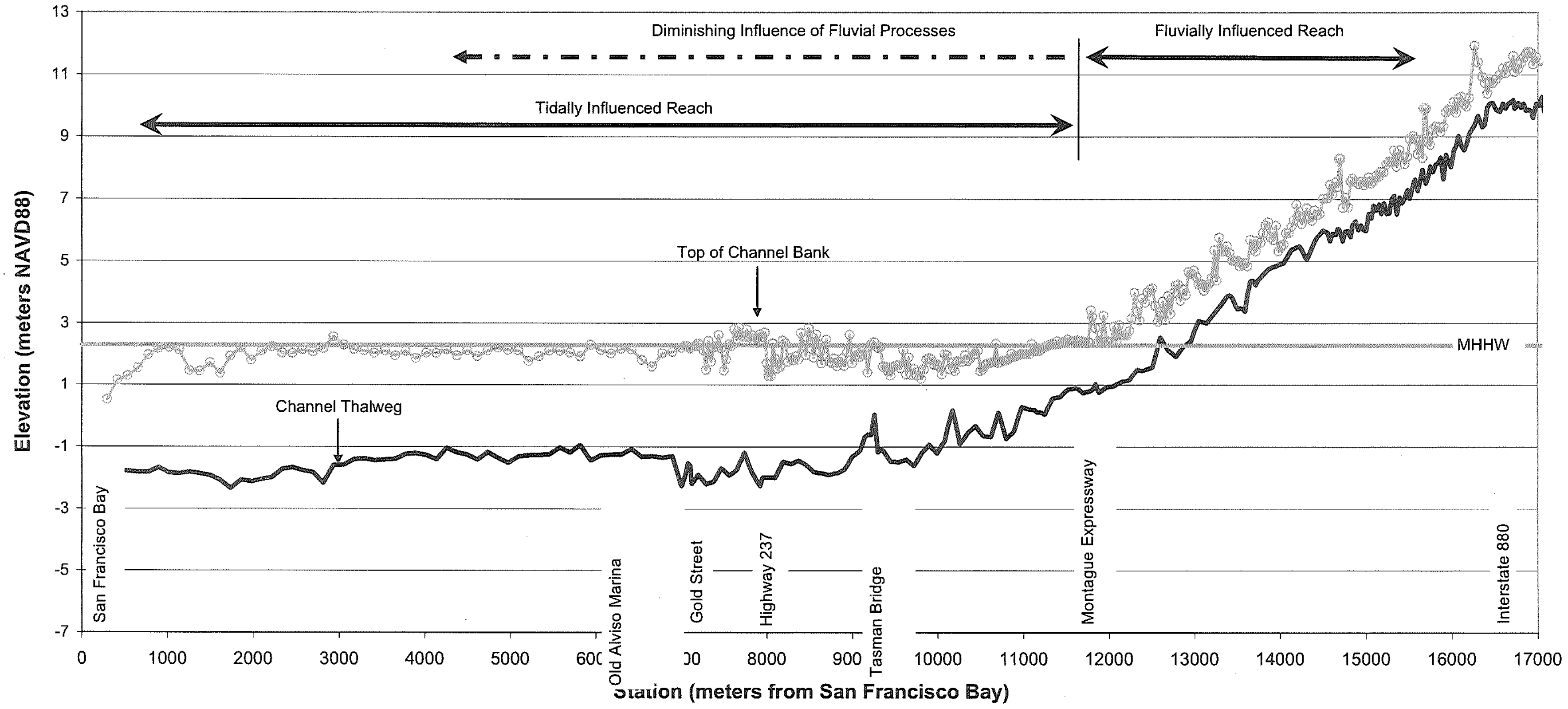

Source: SCVWD HEC-RAS model, with last geometric revision in October 2003. Comments: Thalweg and bank station elevations from HEC-RAS model. Bank stations are as defined in model and may not represent actual levee or overbank elevations. The maximum of the left or right bank elevation was used at each station.

Thalweg Elevation

Maximum Bank Elevation

figure 2

Alviso Slough Restoration Project

Tidal and Fluvial Reaches of Lower Guadalupe River

PWA

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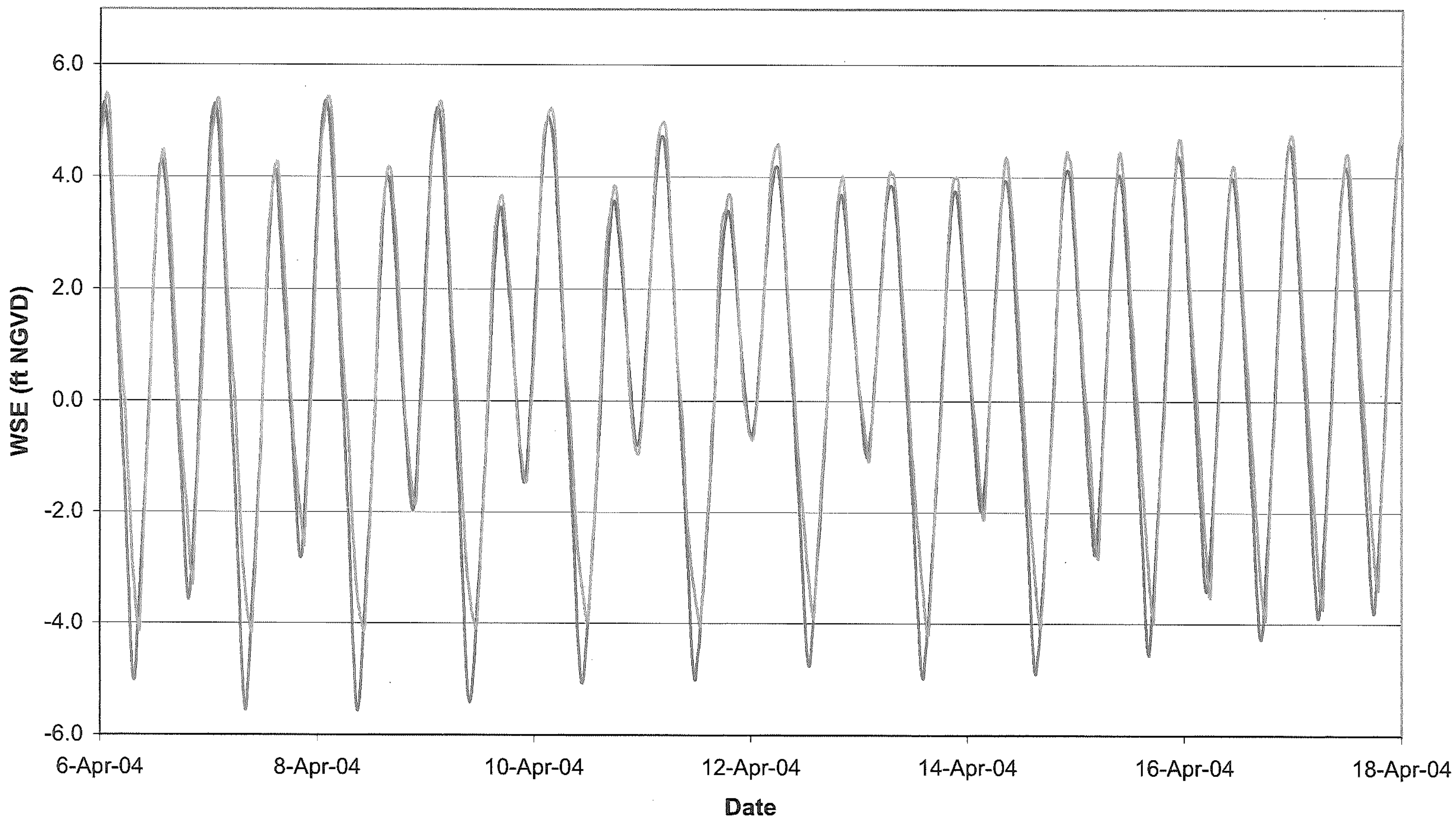


Source: Moffatt and Nichol (2005)

—— Alviso Slough - mouth

—— Alviso Slough - Gold Street

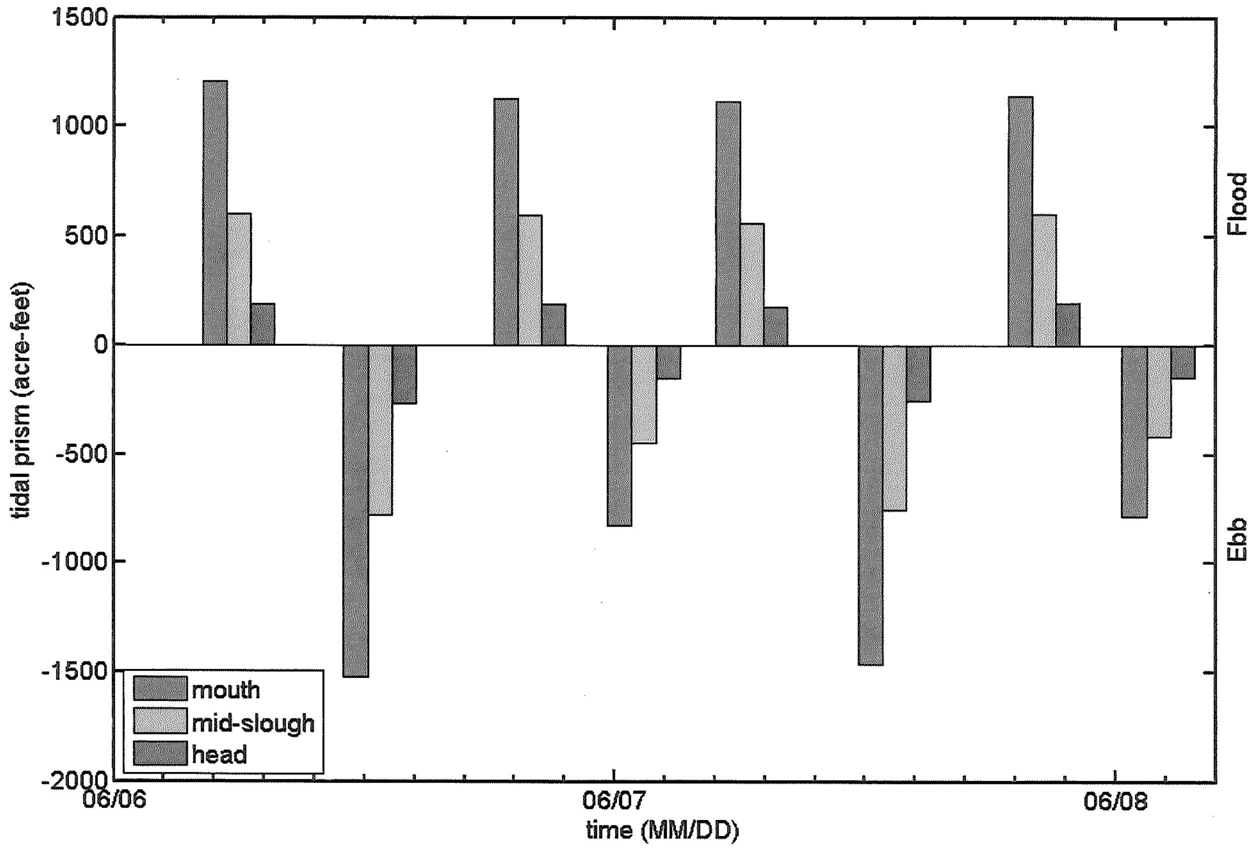
figure 3

Alviso Slough Restoration Project

Water Levels Observed in Alviso Slough

PWA

Fig3_2004tides.xls Excel Graph Box 1/26/2007



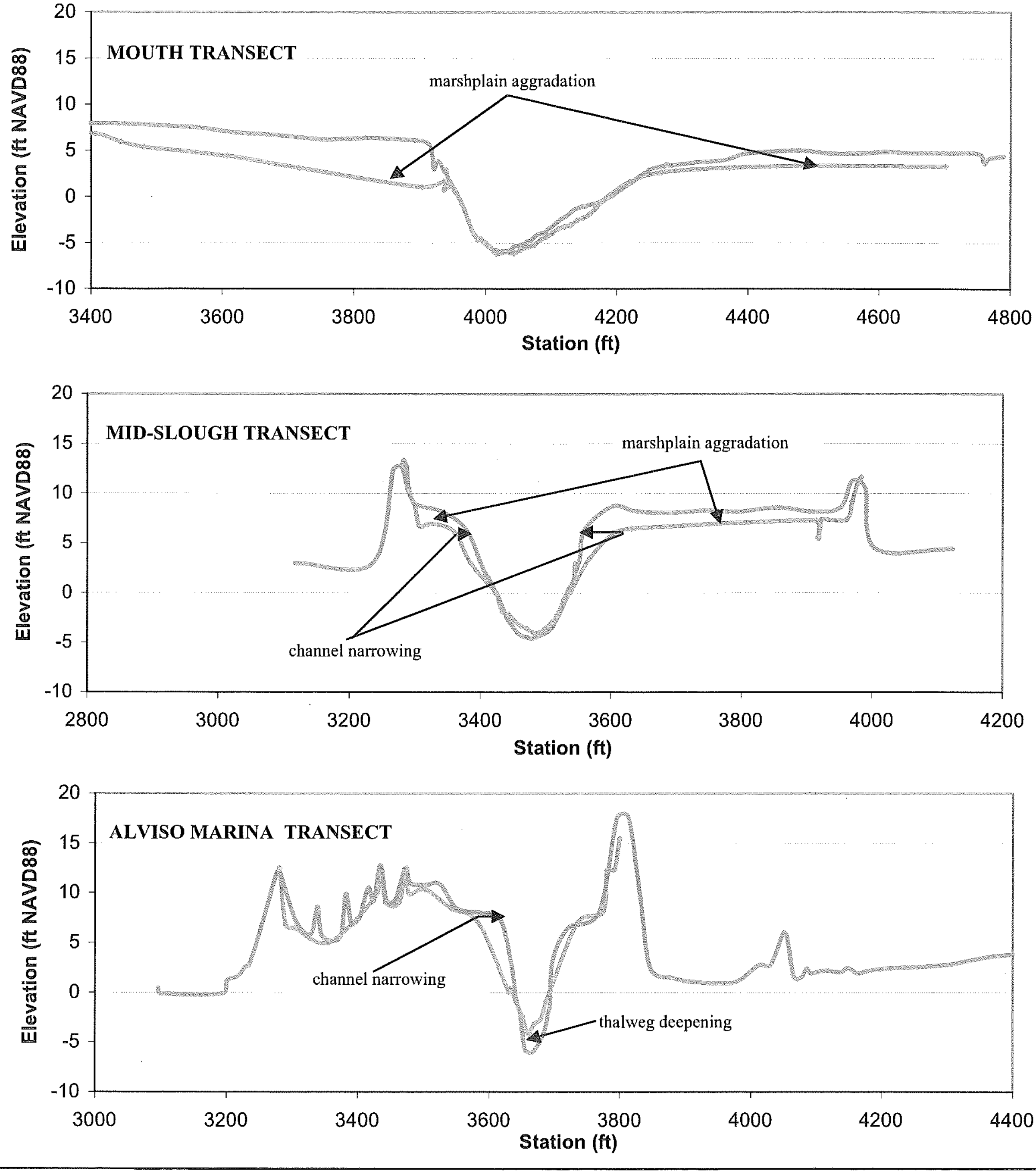
Source: Hydrodynamic modeling (PWA, unpublished)

figure 4

Alviso Slough Restoration Project

Tidal Prism Modeled in Alviso Slough

PWA



Source: SCVWD 1996 and 2004

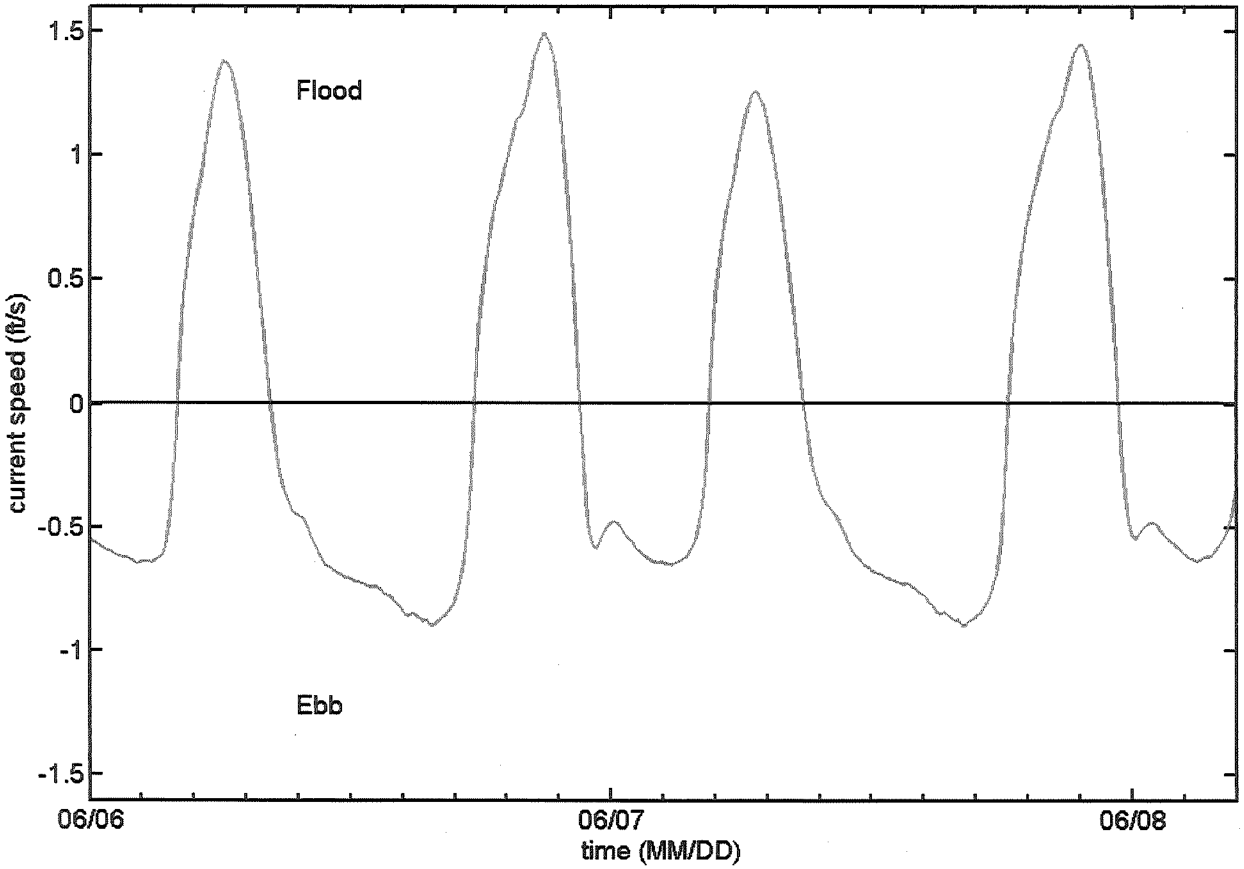
figure 5

Alviso Slough Restoration Project

Channel Cross-Sections

PWA # 1840

PWA



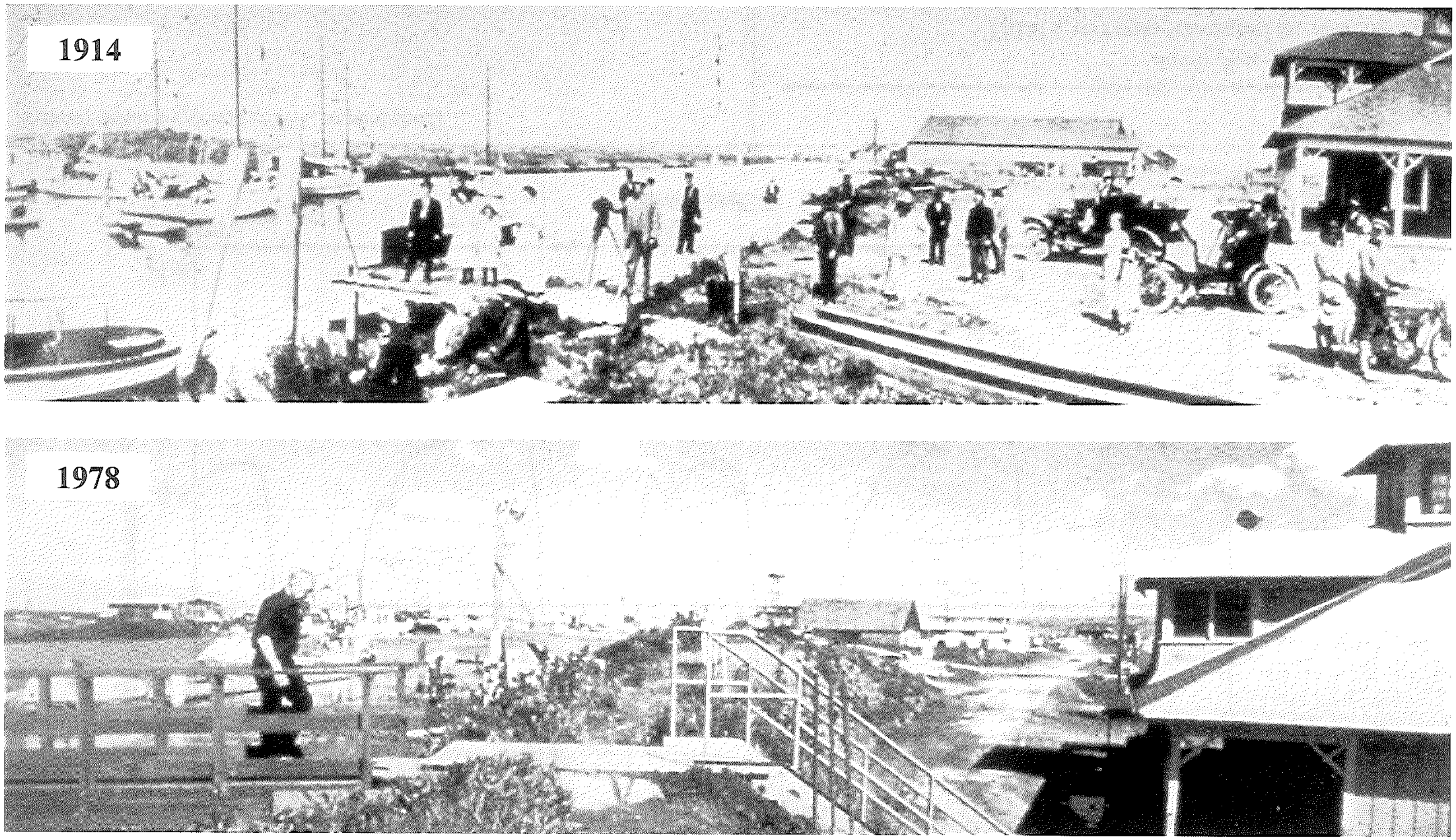
Source: Hydrodynamic modeling (PWA, unpublished)

f i g u r e 6

Alviso Slough Restoration Project

Tidal Currents Modeled in Alviso Slough

PWA



Source: SCVWD

figure 7

Alviso Slough Restoration Project

Historic Photographs of the SBYC

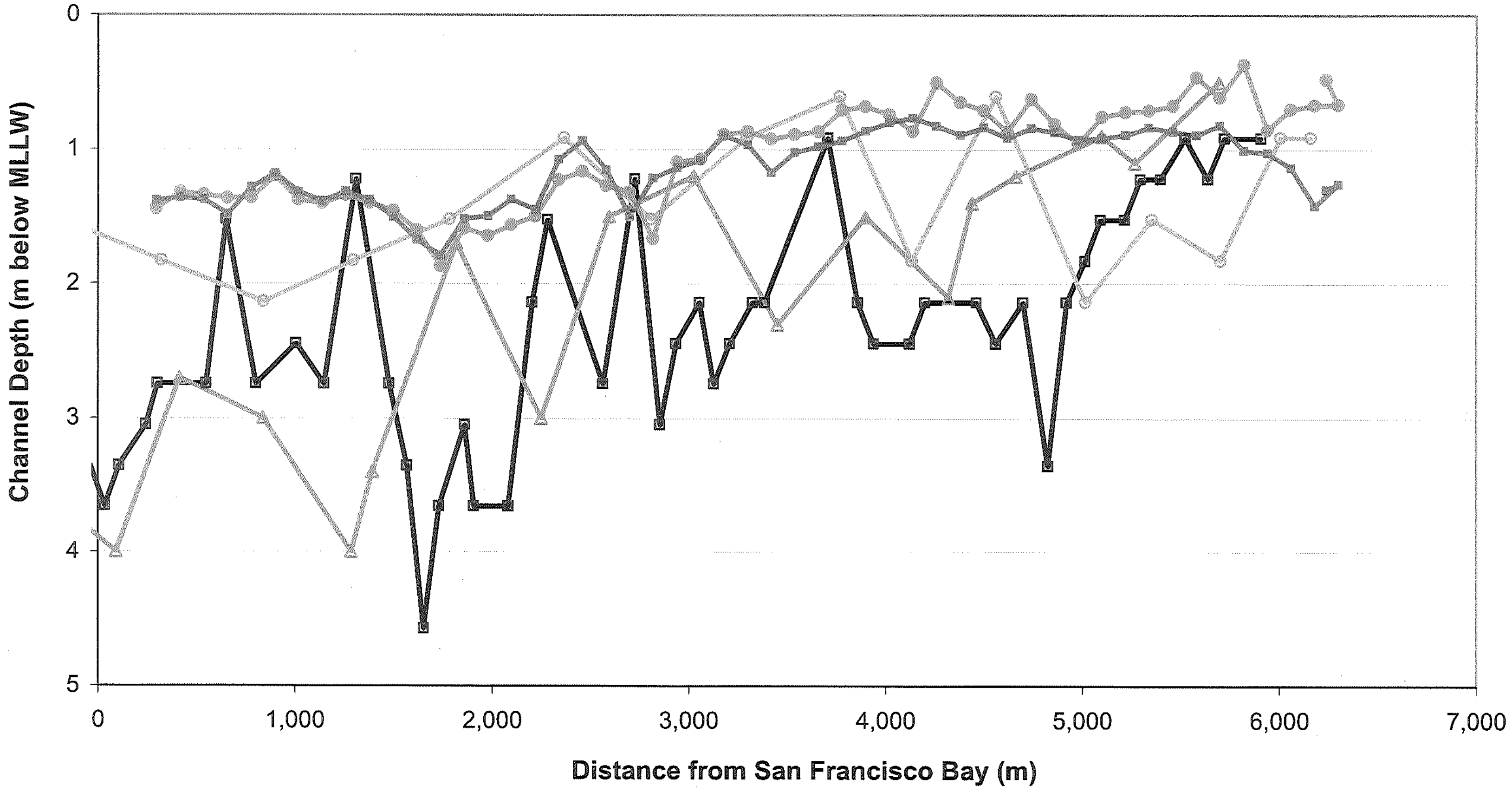


figure 8

Alviso Slough Restoration Project

Alviso Slough Thalweg Evolution

PWA

Appendix E

Alviso Slough Hydraulic Modeling Analysis of Project Alternatives

Santa Clara Valley
Water District

MEMORANDUM

FC 14 (01-02-07)

TO: Alviso Slough Restoration Project Team

FROM: Christy Chung and Liang Xu

SUBJECT: UNET Analyses of Alternatives 1–5

DATE: September 20, 2007
Revised February 20, 2009

Summary

The analyses described in this technical memo were initiated to:

- Determine the flood conveyance capacity and one-percent flood protection impacts of the proposed alternatives for the Alviso Slough Restoration Project on Alviso Slough between Gold Street and the County Marina, and the Alviso Baylands.
- Find solutions for potential impacts.

Background

Based on reports by District staff and comments from Alviso residents, the District Board of Directors approved the following motion on January 20, 2004:

> *That the Board direct staff to prepare a project that includes the following: Phase I, removal of 7 acres of vegetation and root mass to a depth of 4 feet on both banks of the Alviso Slough from the Gold Street bridge to the County Marina; and then in the following year a long term project related to bringing in salt water.*

Philip Williams and Associates (PWA) has assisted the District with the development of project alternatives and the necessary hydraulic analyses to evaluate potential impacts to the existing one-percent flood protection elements in this area. The project alternatives are summarized in Table 1.

Table 1. Summary of Alternatives

Project Alternative	Area Impacted	Work Proposed
Alternative 1	2.6 acres	Vegetation and Root Mass Removal
Alternative 2	7.0 acres	Vegetation and Root Mass Removal
Alternative 3	3.7 acres	Dredging (to 8-foot depth)
Alternative 4	6.2 acres	Dredging (to 16-foot depth)
Alternative 5	25 acres	Vegetation and Root Mass Removal, Dredging (to 10-foot depth)

The project objectives are to:

- Restore Alviso Slough's channel width and habitat to prior to 1983 conditions.
- Improve the community's ability to pursue navigation, access, and aesthetics to encourage the expansion of boating and other recreational and/or tourism opportunities.
- Maintain one-percent flood protection in Alviso Slough.
- Reduce mosquito nuisance.
- Promote the integration with the South Bay Salt Pond Restoration Project (including the Pond A8 Applied Study) to bring salt water connections to the Lower Guadalupe River.

The future implementation of the SBSP Restoration Project Phase 1 was considered during this analysis. One of the planned Phase 1 actions is to construct an armored notch adjacent to the Pond A8N engineered overflow weir. This notch would transform Pond A8N to a muted tidal environment. During the implementation of Phase 1 activities at Pond A8, the SBSP Restoration Program would be monitoring the pond and Alviso Slough for scour, mercury methylization, and fish stranding. Currently, the notch is planned to be closed in the winter due to these concerns.

A photo of the project area taken in 2005 is shown in Figure 1.

2002 Design - Lower Guadalupe River Flood Protection Project (LGRP)

During the design process for the LGRP, Alviso Slough was modeled using both steady and unsteady flow models. Unsteady flow analyses were conducted for the District by Northwest Hydraulic Consultants (NHC). In June 2002 the findings from these analyses were published in a technical memorandum and included in the LGRP Engineer's Report (SCVWD 2002). This study was based on 1996 survey data. The model was created using UNET, a one-dimensional unsteady flow model created by the U. S. Army Corps of Engineers Hydrologic Engineering Center (HEC). For Alviso Slough, the model extended from San Francisco Bay to State Route 237. The following flow condition was modeled: a 10-year tide (high tide elevation of 10.2 feet NAVD88) and a 100-year storm event, with pumped interior drainage flows from the cities of San Jose and Santa Clara, resulting in a peak flowrate of 18,350 cfs in the Lower Guadalupe River at Alviso.

Pond A8N Overflow Weir

Lower Guadalupe River becomes Alviso Slough at the UPRR Bridge. During high flow events, a portion of the flow in Alviso Slough can be conveyed to Pond A8N via a 1,000-foot-long multi-crested engineered weir constructed by the District in 2004 as part of the LGRP. The flood management plan for the LGRP included construction of this weir to allow overflow and temporary storage of Alviso Slough flows that exceed a certain threshold, so as to protect the Town of Alviso from fluvial (river) flooding up to the 1 percent, or 100-year event.

If flows in Alviso Slough downstream of the UPRR Bridge exceed 5,400 cfs (approximately the 8-year return period event), a portion of these flows will overtop the weir and enter Pond A8N. Table 2 provides the 2002 modeled Alviso Slough flows and flows overtopping the Pond A8 weir at the peak of various return period events: the 8-, 10-, 25-, 50- and 100-year flow events. Table 2 also presents the total estimated volume of the spills into Pond A8 over the course of the overflow period, which would last from 15 to 38 hours, depending on the level of the storm event. It should be noted that these modeled flows were based on 1996 survey information for Alviso Slough channel geometry.

Table 2. Alviso Slough Flow Events that Trigger Overflows to Pond A8 via Weir (2002 Model based on 1996 Survey of Alviso Slough Channel Geometry)

Return Period Event	Peak Flow at UPRR Bridge (cfs)	Peak Overflow to Pond A8 (cfs)	Peak Flow in Alviso Slough Downstream of Weir (cfs)	Total Period of Time that Weir Overflow Occurs (hrs)	Total Volume that enters Pond A8 (acre-feet)
8-year	5,400	0	5,400	0	0
10-year	6,700	480	6,200	16	700
25-year	10,000	2,700	7,300	23	4,400
50-year	13,500	4,800	8,700	29	8,900
100-year	18,200	8,500	9,800	38	14,300

As presented in Table 2, under the 1996 channel conditions used in the 2002 LGRP design, for a 100-year event peak flow of 18,350 cfs in Alviso Slough downstream of the UPRR Bridge, hydraulic modeling indicates that, at the peak, about 8,500 cfs would overtop the Pond A8 weir, and about 9,800 cfs (54%) would be conveyed down the slough.

Figure 2 shows the Pond A8 Weir overflow area and the LGRP-engineered flow split. Figure 3 presents a hydrograph (flow over time) for the 100-year event that graphically depicts what flows down Alviso Slough and what overtops the weir and enters Pond A8 during such a storm event.

Since the completion of the LGRP in 2004, the winter storms and subsequent runoff that have occurred on the Guadalupe River have not triggered a single incident of weir overflows.

Pond A5 through A8 Storage System

The pond system that includes Ponds A5, A6, A7, A8S, and A8N (Figure 4), acts as a large storage basin, bounded by Alviso Slough levees to the east, Pond A6 levees to the north, and Guadalupe Slough levees to the west. There are also internal levees that separate the ponds from each other. The flow from pond to pond is controlled by the internal levee elevations. During high flow events, a portion of the flow in Alviso Slough overtops the Pond A8N weir and enters Pond A8N. When flow from Pond A8N reaches an elevation of 3 to 4 feet (NAVD88), flows spill over the internal levees into Ponds A5, A8S, and A7. When water levels in Pond A7 reach an elevation of approximately 5 feet (NAVD88), water will spill into Pond A5. When Ponds A7 and A5 fill to approximately 10 feet NAVD88, water will spill into Pond A6 and also spill from Pond A5 into Guadalupe Slough and out to the Bay. This is illustrated in Figure 4.

In their 2002 report, NHC calculated the available storage volume in the ponds. This volume was based on a "brimful" water elevation in the ponds of 10.26 feet (NAVD88). The available storage volumes are shown in Table 3.

Table 3. Available Pond Storage

Pond Number	Surface Area	Pre-Storm Elevation	Maximum Stage	Maximum Pond Volume Available for Storing Overflows
	(acres)	(ft NAVD88)	(ft NAVD88)	(acre-ft)
A8W	414.77	0.53	10.26	4,000
A5	626.78	2.85	10.26	4,600
A8D	181.24	2.90	10.26	1,400
A7	259.81	2.81	10.26	1,900
~~A6~~	~~342.62~~	~~3.00~~	~~10.26~~	~~2,500~~
Total				**11,900**

Currently, there are plans to return Pond A6 to tidal conditions.

There are currently plans to breach the bayside levees on Pond A6, restoring it to full tidal conditions. Thus, it will no longer be available to provide temporary storage of Alviso Slough overflows to Pond A8.

Based on the modeled flow conditions for various storm return period events as presented in Table 2, the total volume of overflow would be contained by Ponds A5–A8 for the 10-, 25-, and 50-year events. Overflow volumes from an event close to the 100-year event would exceed the available storage capacity of the pond system.

Guadalupe Slough

Guadalupe Slough borders the pond system on the west, as shown in Figure 4. It conveys flows from Sunnyvale East Channel, Sunnyvale West Channel, Calabazas Creek, and San Tomas Aquino Creek to San Francisco Bay. A one-percent flood event was also simulated for Guadalupe Slough. As stated in the previous paragraph, the modeled overflow volume for an event close to the 1 percent or 100-year event would exceed the available storage of Ponds A5–A8. There are low spots on the Guadalupe Slough east levee bordering Pond A5. In a one-percent event, it is likely that up to 2,500 acre-feet of water may overtop the levee along Pond A5 and enter Guadalupe Slough. The timing of this overflow is such that it would occur after the peak flow in Guadalupe Slough has passed; thus, there are no adverse impacts of flooding anticipated along Guadalupe Slough.

LGRP Ongoing Capacity Assessment

To assess the required operations and maintenance work for the LGRP, the O&M Plan for the LGRP includes conducting cross-section surveys of the Alviso Slough channel geometry every five years. The first such survey was performed in 2004, and the next scheduled survey is in 2009. In addition, annual marsh studies are conducted by the City of San Jose and provide data on vegetation growth in Alviso Slough.

2005 Updated Hydraulic Modeling Based on 2004 Channel Surveys

As per the LGRP O&M Plan, cross-section surveys of Alviso Slough between Union Pacific Railroad (UPRR and San Francisco Bay were conducted in 2004 by the Santa Clara Valley Water District's Land Surveying and Mapping Unit. The hydraulic models for Alviso Slough flood management were updated in 2005 based on the new channel cross-section information, and are referred to herein as the 2005 Condition.

The NHC 2002 Design UNET model was modified to reflect the 2004 survey data. The hydraulic modeling using the updated survey information indicated that the slough has experienced a reduction in conveyance capacity since the 2002 LGRP design, due primarily to encroachment of vegetation in the slough. Table 4 presents the modeled flow events that would trigger overflows to Pond A8 via the weir under the updated 2005 Condition.

Table 4. Alviso Slough Flow Events that Trigger Overflows to Pond A8 via Weir (2005 Model based on 2004 Survey of Alviso Slough Channel Geometry)

Return Period Event	Peak Flow at UPRR Bridge (cfs)	Peak Overflow to Pond A8 (cfs)	Peak Flow in Alviso Slough Downstream of Weir (cfs)	Total Period of Time that Weir Overflow Occurs (hrs)	Total Volume that enters Pond A8 (acre-feet)
8-year	5,400	0	5,400	0	0
10-year	6,700	800	5,900	16	900
25-year	10,000	3,200	6,800	23	4,800
50-year	13,500	5,700	7,800	29	9,600
100-year	18,200	10,000	8,300	38	17,100

In comparing the modeling results in Table 4 with those for the 1996 survey channel conditions in Table 2, the overflows to the weir are triggered for the same return-period events. The changed slough conditions would not trigger a more frequent occurrence of weir overflows. However, as shown in Table 4, the level of flows over the weir is increasing, and the total volume of the overflows for each of the listed events would increase as well.

For the 1 percent or 100-year event, the changed conditions in the slough would nearly reverse the modeled flow split. As shown in Table 2, based on 1996 conditions, the flow over the weir at peak was 8,500 cfs, and the flow remaining in Alviso Slough at peak was 9,800 cfs. As seen in Table 4, the reduced conveyance capacity of Alviso Slough, as documented by the 2004 surveys, would result in 10,000 cfs at the peak of weir overflow, and only 8,300 cfs at peak flow in Alviso Slough.

Comparing the total volume of the overflows to the Pond A5-A8 system in Table 4 with the available storage in Table 3, the overflow volume for the 50-year event would still be contained by the available storage, but if a 1 percent or 100-year event occurred, an excess of approximately 5,500 acre-feet would eventually spill over the Pond A5 levees into Guadalupe Slough.

2007 Hydraulic Modeling for Alviso Slough Restoration Project

Modeling Approach

To assess the potential effects of the proposed alternatives for the Alviso Slough Restoration Project, the 2005 Condition model was used and modified as appropriate to reflect the changed slough conditions between Gold Street and the Alviso County Marina for each alternative.

The footprints of the five alternatives were plotted with the cross-section cut lines from the 2004 survey of Alviso Slough completed by the District's Land Surveying and Mapping Unit. A plan view of the five alternatives is shown in Figures 5 to 9. Based on the cross-section change schematic provided by PWA, shown in Figure 10, the cross-section geometry for each cross-section was changed accordingly.

Channel roughness was also adjusted in the UNET model. NHC had used a Manning's n-value of 0.03 to represent the open water channel, and 0.2 to represent the vegetated overbanks. These values were maintained in the UNET model, but the extent of the open water channel was adjusted to reflect the change in channel geometry for each of the alternatives. An n-value of 0.045 was used for the areas with vegetation/root mass removal but no dredging.

Findings

The UNET model results indicate that all the project alternatives would create changes in the Alviso Slough water surface elevation profile between Gold Street and the Alviso County Marina. Table 5 shows the modeled peak flow split between Pond A8N and Alviso Slough for the five project alternatives during a 1-percent event.

Table 5. Impact of Project Alternatives on Modeled Flow Split Between Pond A8N Weir Overflows and Alviso Slough Conveyance for the 1-Percent (100-Year) Event

Condition	Peak Flow to Pond A8W	Peak Flow in Alviso Slough	Total Peak Flow in One-Percent Event	Is Alviso Slough Conveyance Capacity Exceeded?	If Yes, By How Much?
	(cfs)	(cfs)	(cfs)		
2005	10,000	8,300	18,300	No	
Alternative 1	9,800	8,500	18,300	Yes	200
Alternative 2	9,400	8,900	18,300	Yes	600
Alternative 3	9,600	8,700	18,300	Yes	400
Alternative 4	8,900	9,400	18,300	Yes	1,100
Alternative 5	9,000	9,300	18,300	Yes	1,000

With increasing areas of removal of vegetation and root mass for Alternatives 1 and 2, and the dredging of the channel in Alternatives 3 and 4, the hydraulic capacity of Alviso Slough between Gold Street and the Alviso County Marina is progressively increased. The results in Table 5 indicate that the flowrate overtopping the weir at peak flow would decrease, while the flowrate conveyed via Alviso Slough during peak flow would increase.

For Alternative 5, approximately 10 acres of the slough would be dredged and an additional 15 acres would be cleared of vegetation and root mass. Because of less dredging downstream of the weir, the water surface elevation there is higher than that of the Alternative 4. Even with more vegetation removal near the weir, the water surface profile is still higher than that of Alternative 4 due to the backwater effect. Therefore, the peak overflow rate at the weir increases slightly for Alternative 5.

Levees

As established by the 2004 surveyed slough conditions, the channel downstream of the Alviso County Marina can only convey approximately 8,300 cfs without overtopping the levees along Ponds A11 and A12. As shown in Table 5, all proposed project alternatives would convey more flow than the slough channel's capacity in a 1-percent event, which could overtop these levees. To mitigate for this impact, the engineered weir at Pond A8N would have to be lowered to divert more flow to the pond system, and thus reduce the water surface elevations for the remaining flows that are conveyed downstream along Alviso Slough. For each proposed project alternative, Table 6 presents the necessary extent of the Pond A8N weir modification. Table 6 also presents the resultant modeled flow splits, which are similar to the 2005 modeled condition as presented in Table 4.

Table 6. Modeled Flow Split Between Pond A8N Weir Overflows and Alviso Slough Conveyance—Project Alternatives

Project Alternative	Slough Area Impacted (acres)	Extent of Lowering Pond A8 Weir (all elevations NAVD88)	Length of Weir Modification (ft)	Resulting Modeled Flows to Pond A8N* (cfs)	Resulting Modeled Flows in Alviso Slough d/s of A8N Weir* (cfs)
1	2.6	1.3 ft (to el. 11.4 ft)	200	10,100	8,200
2	7.0	1.4 ft (to el. 11.4 ft)	350	10,000	8,300
3	3.7	1.3 ft (to el. 11.4 ft)	200	10,000	8,300
4	6.2	0.7 ft (to el. 10.7 ft) 1.4 ft (to el. 11.4 ft)	630 370	10,100	8,200
5	25	0.5 ft (to el. 10.9 ft) 1.4 ft (to el. 11.4 ft)	630 370	10,000	8,300

**Note: Modeled flows represent flow split at peak flow (18,350) of a one-percent event.*

South Bay Salt Pond Restoration Project Phase 1 Actions

The hydraulic analyses performed for the evaluation of the Alviso Slough Restoration Project alternatives assumed, conservatively, that the proposed SBSP Phase 1 action—an armored notch at Pond A8N that would restore a muted tidal action to Alviso Slough—is not in place. If the notch is constructed and opened to its maximum width (40 feet) on a year-round basis, it would provide an additional means for high flood flows to enter the pond system and the stated weir modifications in Table 6 would be reduced. Since the full use of the proposed notch is not assured at this time, it is recommended that the weir modifications presented in Table 6 be incorporated into the project work for the project alternative that will be approved for implementation.

Frequency of Overflows to Pond A8N

Under the 2002 design condition (Table 2), flows would overtop the Pond A8N weir when flow in Alviso Slough would exceed 5,400 cfs. As shown in Table 5, under the 2005 condition, flows would also begin to overtop the Pond A8N weir when Alviso Slough flows would exceed 5,400 cfs. The proposed weir modifications presented in Table 6 for the five proposed project alternatives would maintain the 2005 condition of weir and flow splits. Thus, implementing the proposed project would not increase the frequency of weir overflow events.

References

Northwest Hydraulic Consultants; June 3, 2002; *Evaluation of Effects of Interior Drainage Flows on LGR Hydraulic Conditions—Tech Memo.*

Philip Williams & Associates, Ltd., et al; 2007; *South Bay Salt Pond Restoration Project Final Alternatives Report.*

Santa Clara Valley Water District, Jones and Stokes Associates, CH2M-Hill, Northwest Hydraulic Consultants, and H. T. Harvey and Associates; June 6, 2002; *Lower Guadalupe River Planning Study: Engineer's Report.*

Santa Clara Valley Water District, 2007, *Feasible Project Alternatives Technical Memorandum.*

Santa Clara Valley Water District, 2007, *Alviso Baylands Analysis, Lower Guadalupe River Flood Protection Project Ongoing Capacity Assessment.*

Christy Chung

Christy K. Chung, P.E.
Assistant Civil Engineer II
Hydraulic Engineering Unit

Liang Xu

Liang Xu, P.E.
Senior Engineer
Hydraulic Engineering Unit

cc: B. Goldie, K. Oven, B. Ganjoo, A. Gurevich, D. Jacques, B. Dyer, J. Lo

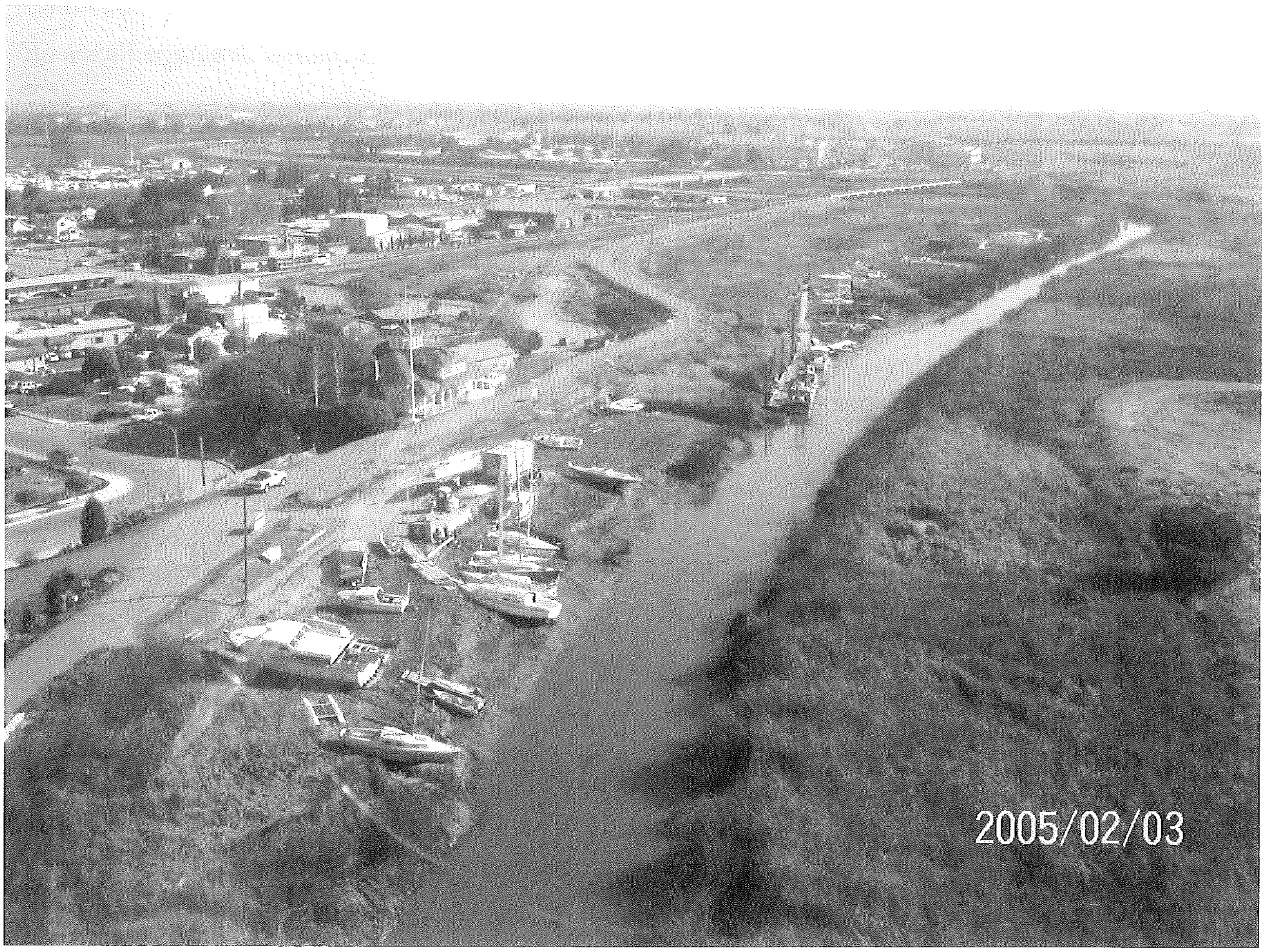

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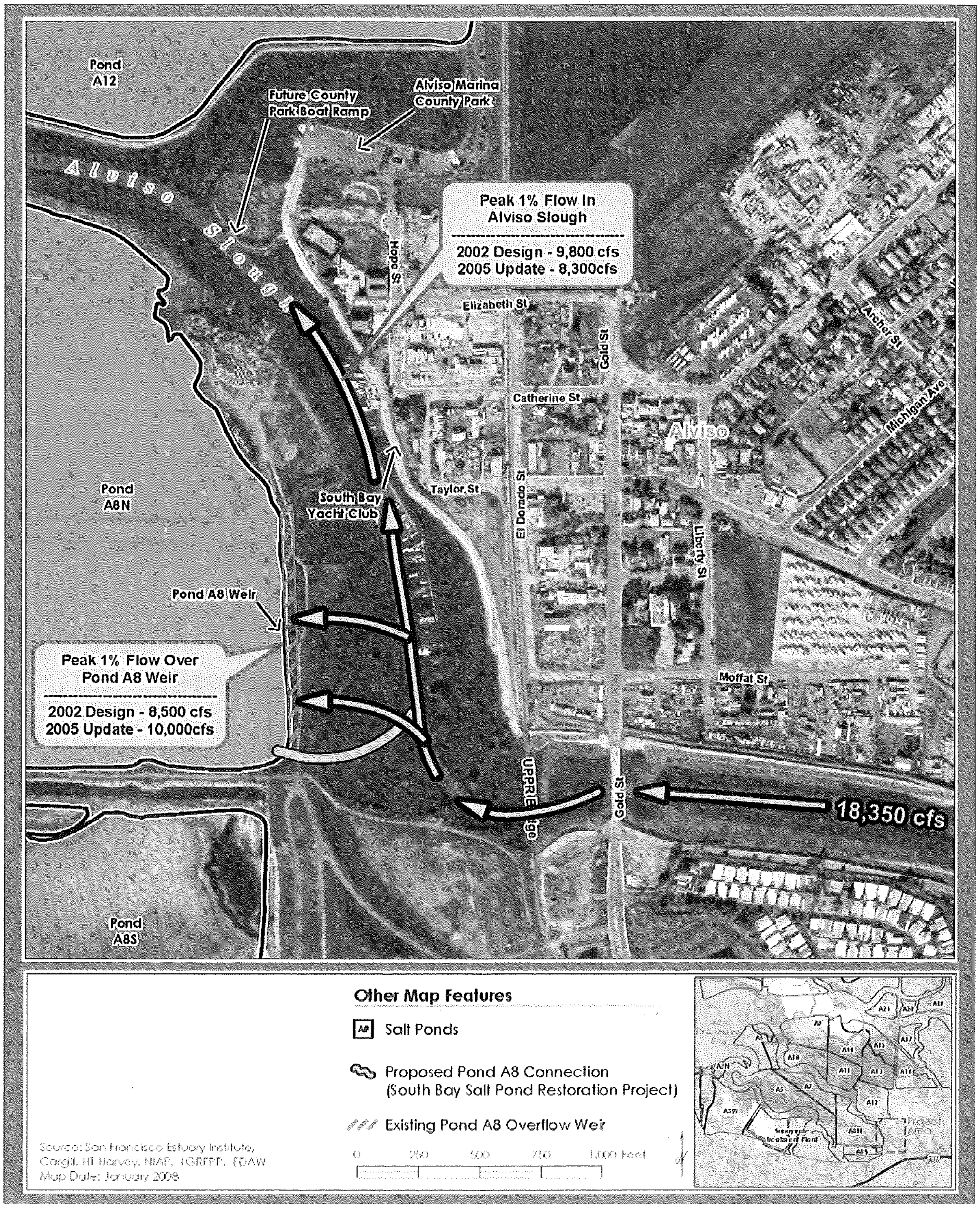
Figure 1. Photo of Alviso Slough Restoration Project Area Looking Upstream from Vicinity of Alviso County Marina



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, IGREPP, EDAW
Map Date: January 2008

Figure 2. Portion of Lower Guadalupe River System

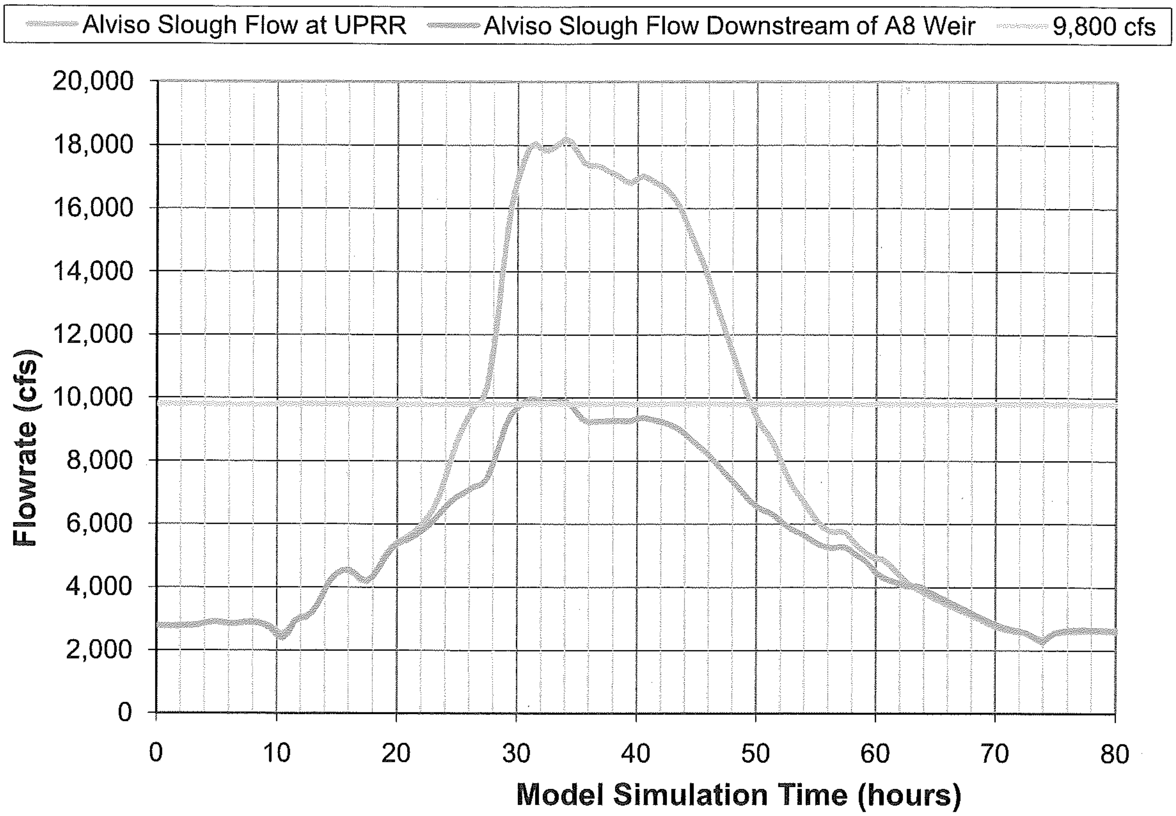


Figure 3. Flow Split

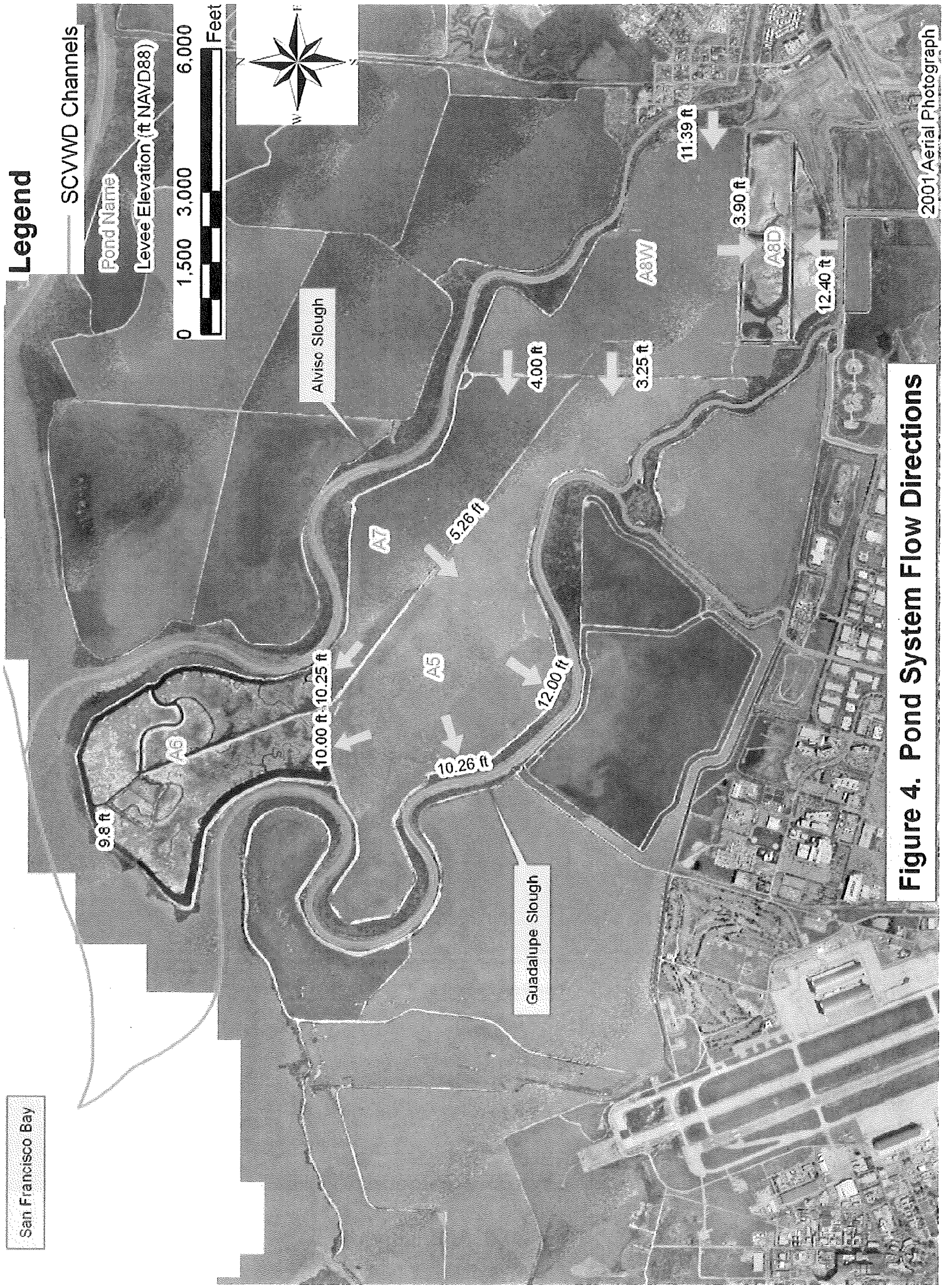
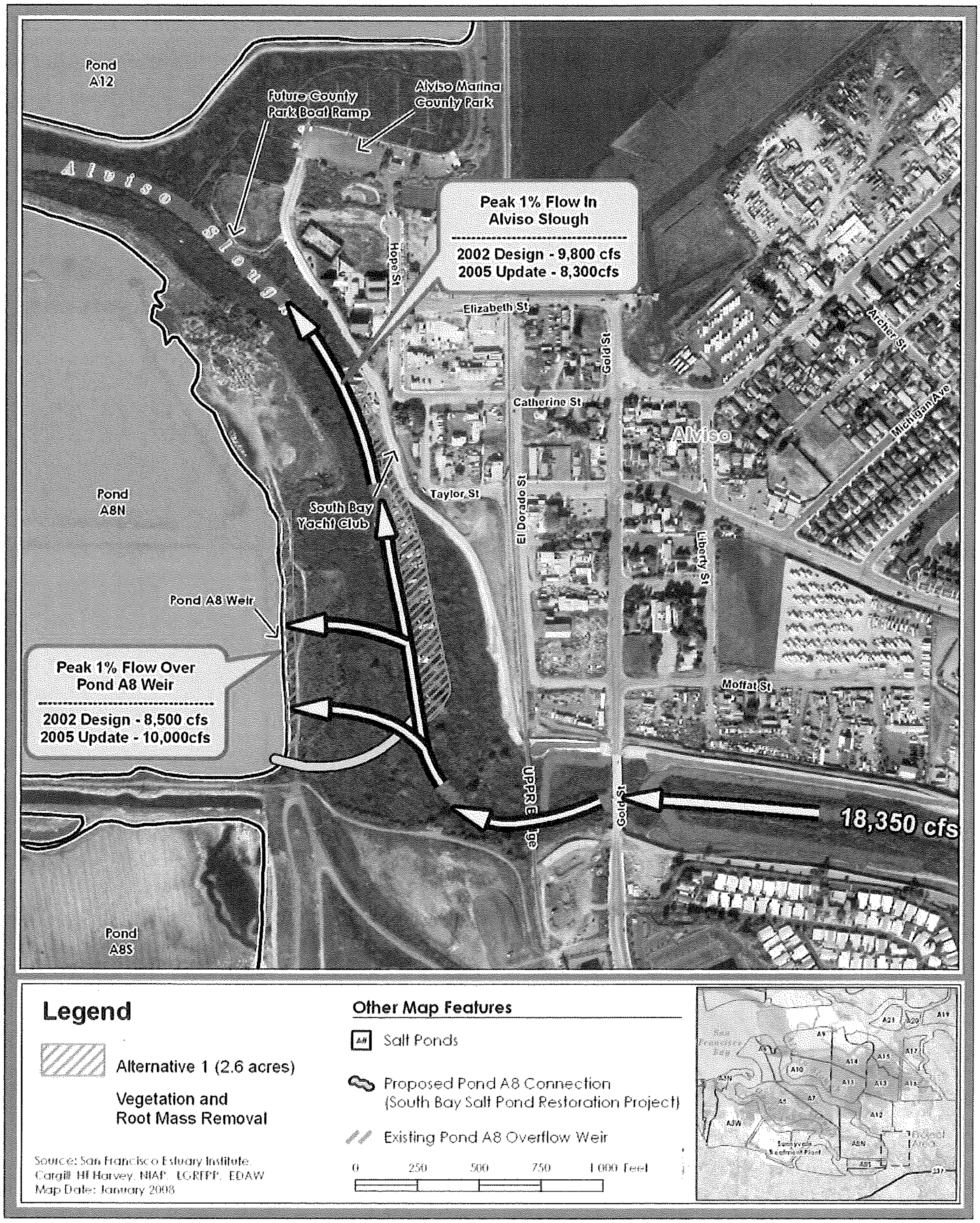


Figure 4. Pond System Flow Directions



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: January 2008

Figure 5. Alternative 1

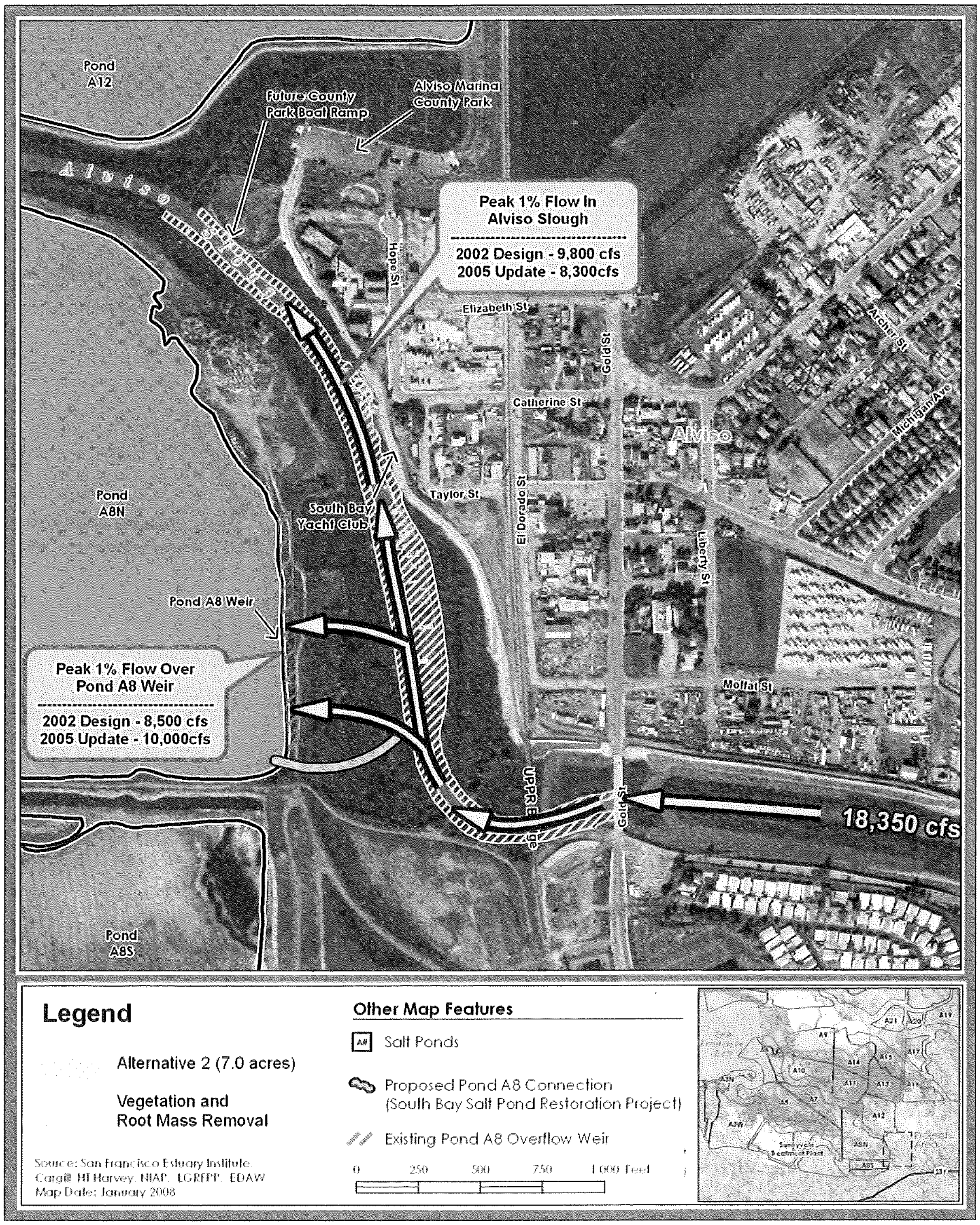
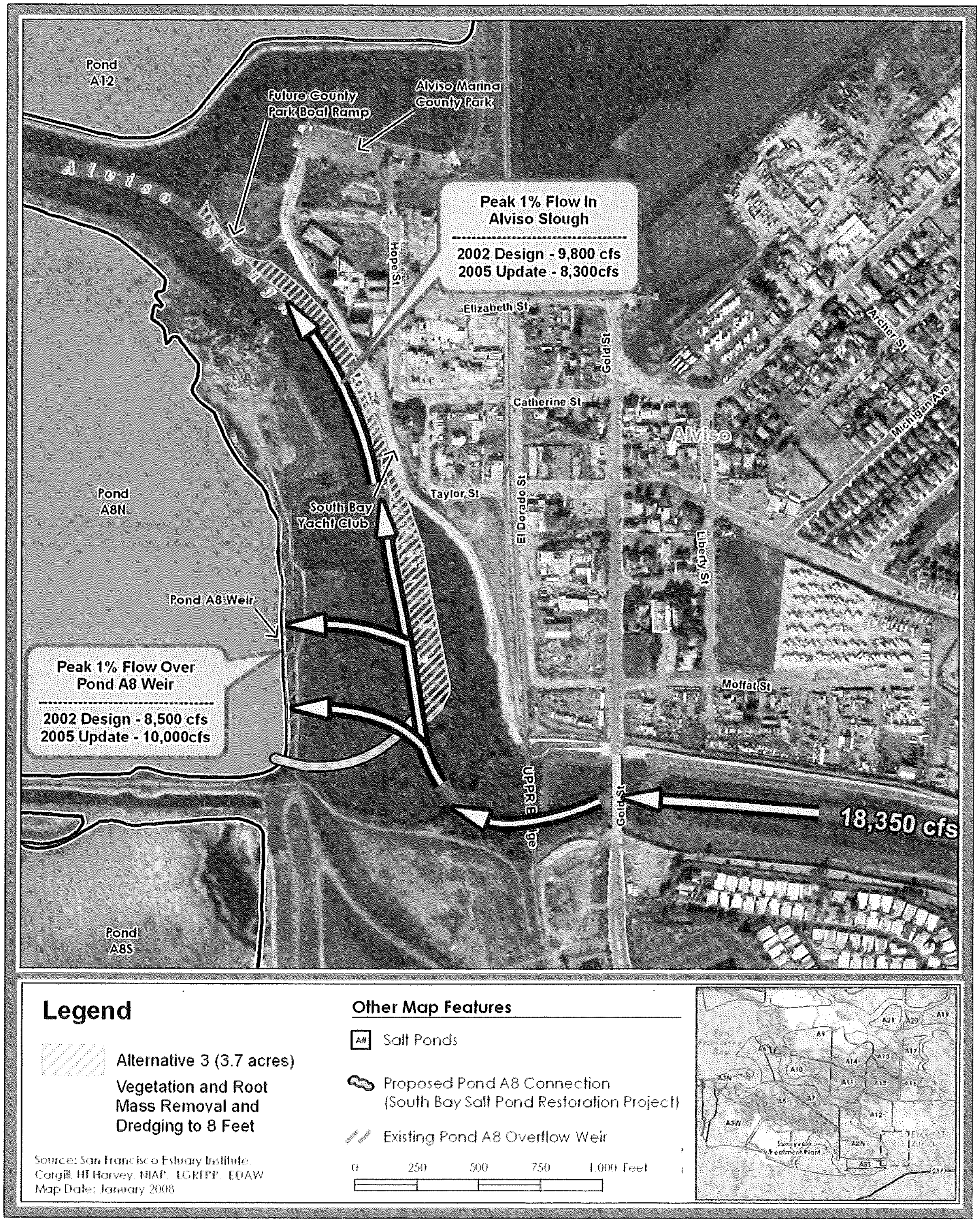


Figure 6. Alternative 2

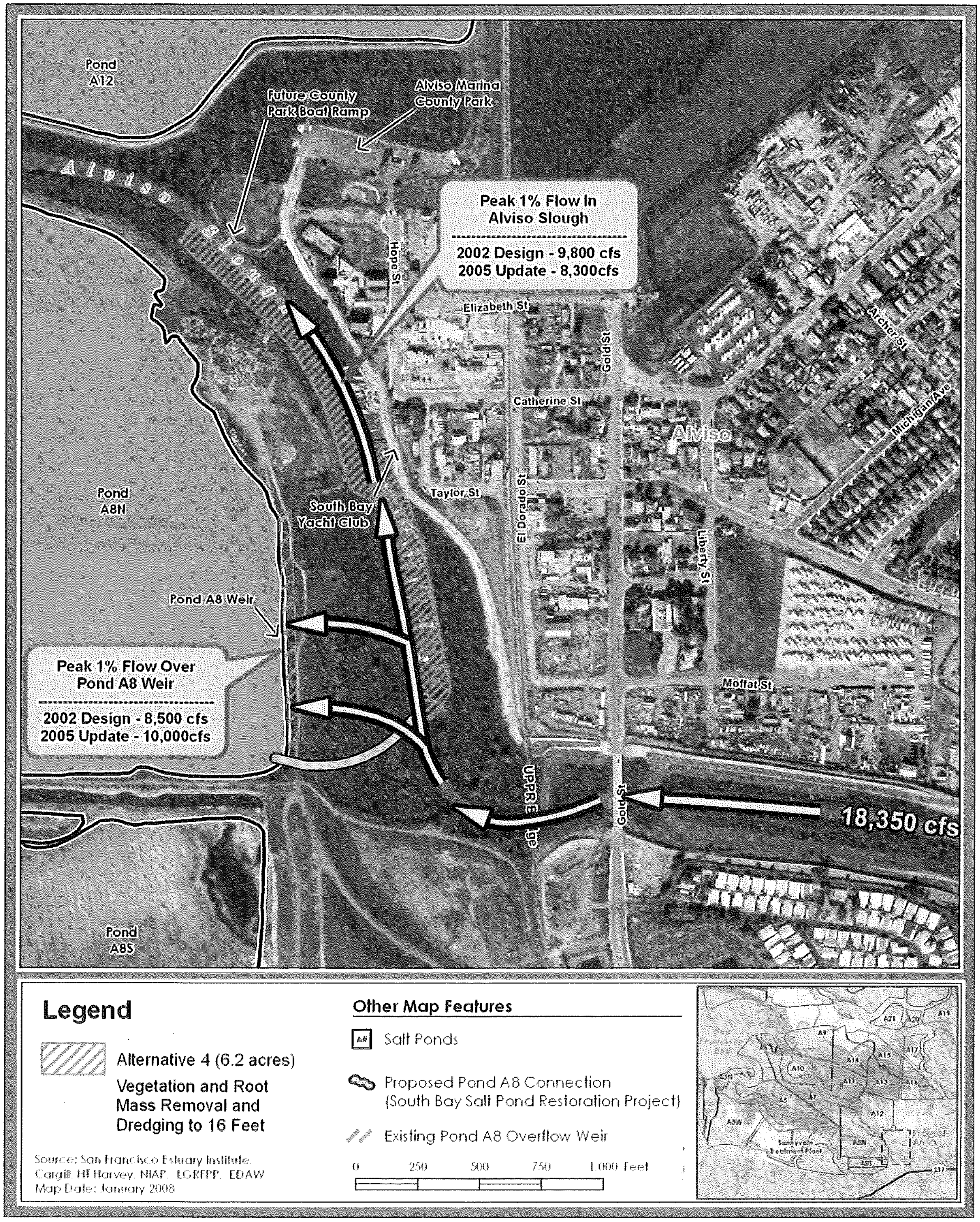


Peak 1% Flow In
Alviso Slough
2002 Design - 9,800 cfs
2005 Update - 8,300cfs

Peak 1% Flow Over
Pond A8 Weir
2002 Design - 8,500 cfs
2005 Update - 10,000cfs

Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: January 2008

Figure 7. Alternative 3



Peak 1% Flow In Alviso Slough

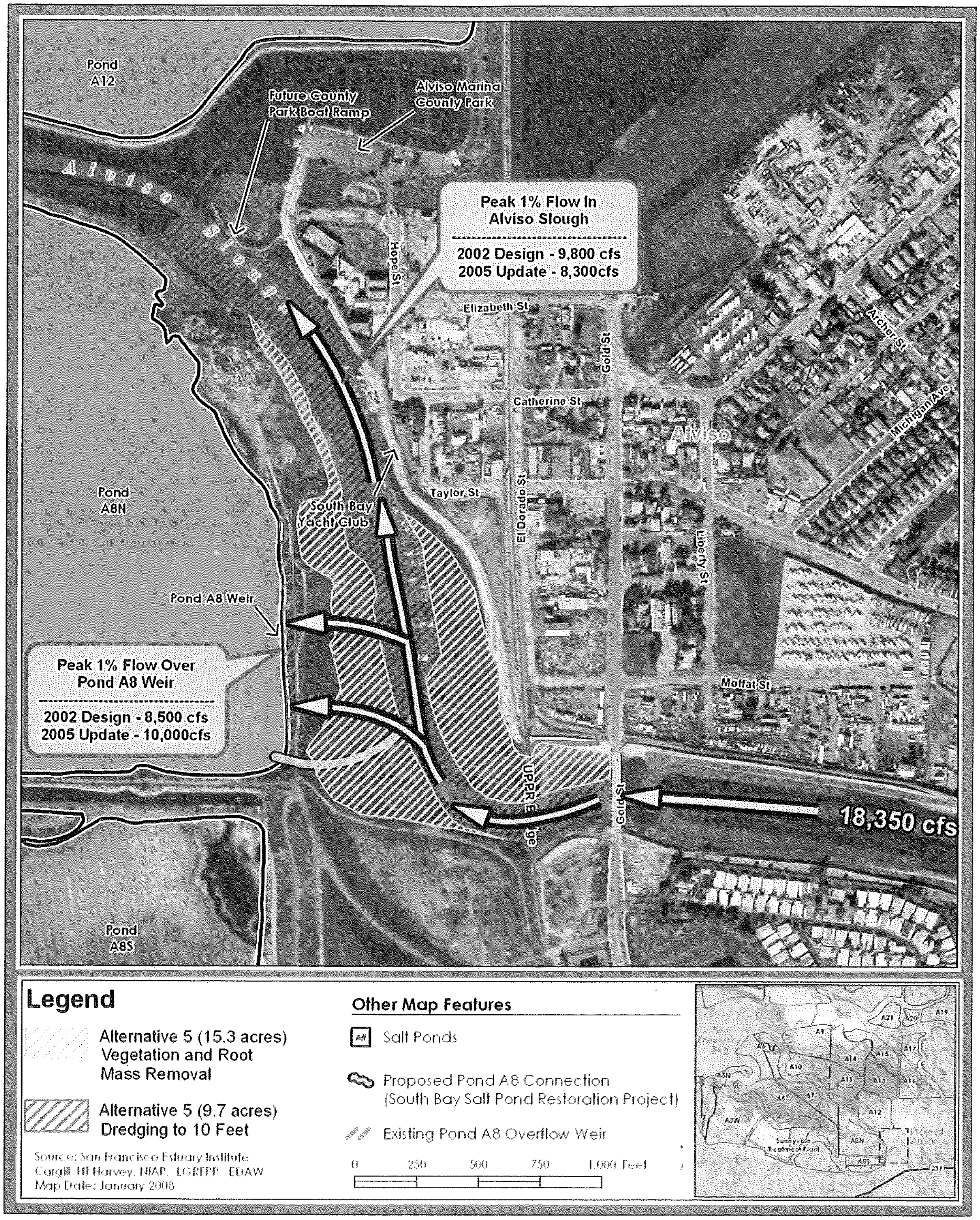
2002 Design - 9,800 cfs
2005 Update - 8,300cfs

Peak 1% Flow Over Pond A8 Weir

2002 Design - 8,500 cfs
2005 Update - 10,000cfs

Source: San Francisco Estuary Institute. Cargill. HT Harvey. NIAP. LGRFPP. EDAW
Map Date: January 2008

Figure 8. Alternative 4



Source: San Francisco Estuary Institute, Cargill, HT Harvey, NIAP, LGRFPP, EDAW
Map Date: January 2008

Figure 9. Alternative 5

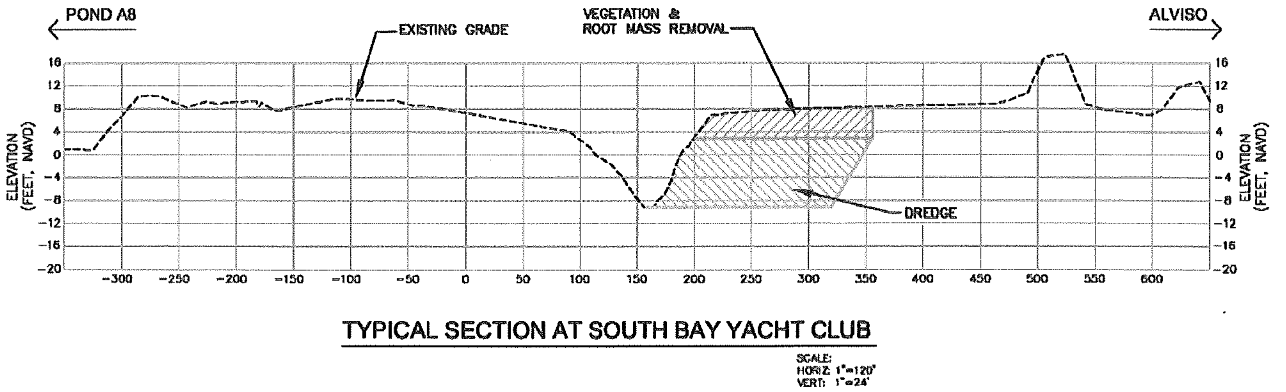
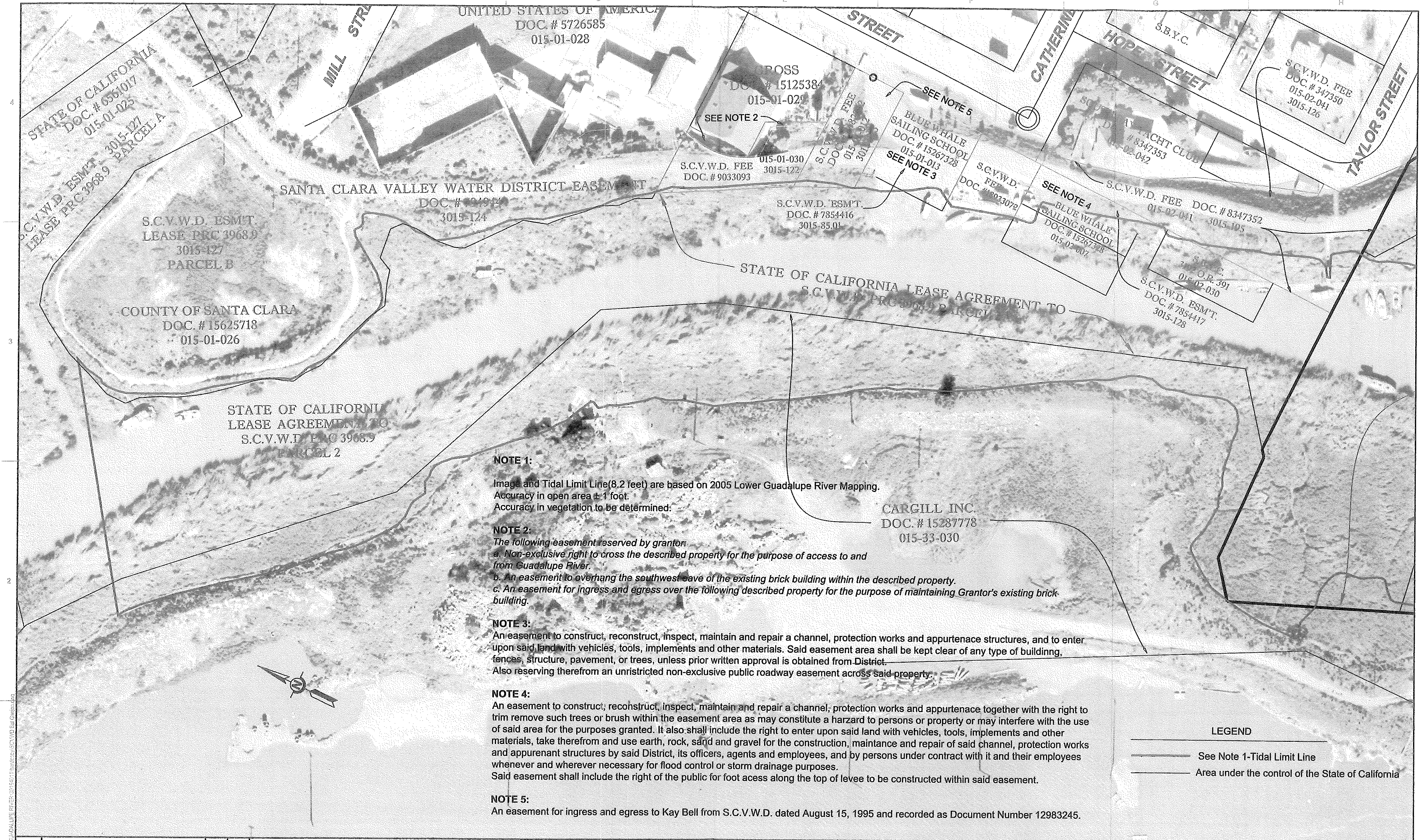


Figure 10. Conceptual Vegetation & Root Mass Removal and Dredge
Source: PWA

Appendix F

Alviso Slough Project Area Land Ownership Maps



NOTE 1:

Image and Tidal Limit Line(8.2 feet) are based on 2005 Lower Guadalupe River Mapping.
Accuracy in open area ± 1 foot.
Accuracy in vegetation to be determined.

NOTE 2:

The following easement reserved by grantor:
a. Non-exclusive right to cross the described property for the purpose of access to and from Guadalupe River.
b. An easement to overhang the southwest eave of the existing brick building within the described property.
c. An easement for ingress and egress over the following described property for the purpose of maintaining Grantor's existing brick building.

NOTE 3:

An easement to construct, reconstruct, inspect, maintain and repair a channel, protection works and appurtenace structures, and to enter upon said land with vehicles, tools, implements and other materials. Said easement area shall be kept clear of any type of buildinng, fences, structure, pavement, or trees, unless prior written approval is obtained from District.
Also reserving therefrom an unristricted non-exclusive public roadway easement across said property.

NOTE 4:

An easement to construct, reconstruct, inspect, maintain and repair a channel, protection works and appurtenace together with the right to trim remove such trees or brush within the easement area as may constitute a harzard to persons or property or may interfere with the use of said area for the purposes granted. It also shall include the right to enter upon said land with vehicles, tools, implements and other materials, take therefrom and use earth, rock, sand and gravel for the construction, maintance and repair of said channel, protection works and appurenant structures by said District, its officers, agents and employees, and by persons under contract with it and their employees whenever and wherever necessary for flood control or storm drainage purposes.
Said easement shall include the right of the public for foot acess along the top of levee to be constructed within said easement.

NOTE 5:

An easement for ingress and egress to Kay Bell from S.C.V.W.D. dated August 15, 1995 and recorded as Document Number 12983245.

LEGEND

▬	See Note 1-Tidal Limit Line
—	Area under the control of the State of California

REV	DESCRIPTION	DATE	APPR

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DRAWN
CHECKED

Santa Clara Valley Water District

MAPPING CERTIFICATION
LAND SURVEYOR L.S. NO.

ENGINEERING CERTIFICATION
CIVIL ENGINEER R.C.E. NO.

Figure F-1
Alviso Slough Restoration
Project Area Land Ownership

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SCALE
1" = 60'
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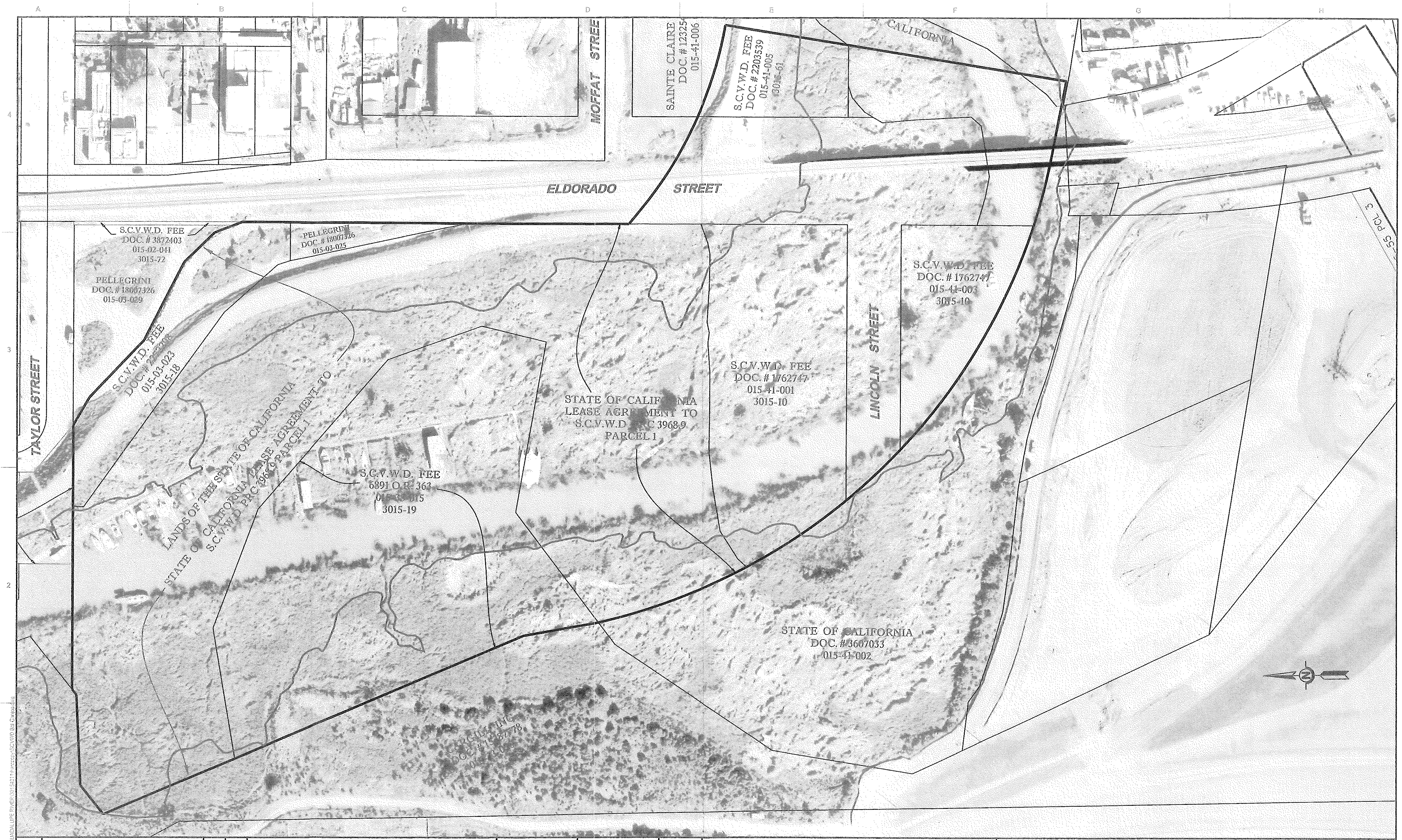
1 OF 1



REV | DESCRIPTION | DATE | APPR

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Figure F-2
Alviso Slough Restoration
Project Area Land Ownership

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SCALE
1" = 60'

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2
1 OF 1